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A

DICTIONARY

OF

PRACTICAL SURGERY:

COMPREHENDING

ALL THE MOST INTERESTING IMPROVEMENTS, FROM THE EARLIEST
TIMES DOWN TO THE PRESENT PERIOD;

AN ACCOUNT OF THE INSTRUMENTS AND REMEDIES EMPLOYED IN
SURGERY;

THE ETYMOLOGY AND SIGNIFICATION
OF THE
PRINCIPAL TERMS;

AND NUMEROUS REFERENCES TO ANCIENT AND MODERN WORKS,
FORMING A CATALOGUE OF SURGICAL LITERATURE, ARRANGED ACCORDING
TO SUBJECTS.

THE SEVENTH EDITION,
REVISED, CORRECTED, AND ENLARGED.

BY SAMUEL COOPER,

SENIOR SURGEON TO UNIVERSITY COLLEGE HOSPITAL;
PROFESSOR OF SURGERY IN THE SAME COLLEGE; SURGEON TO THE QUEEN'S
BENCH; ETC. ETC. ETC.

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PREFACE

TO THE

SEVENTH EDITION.

THE utility of this DICTIONARY to students, and all classes of medical practitioners, has obtained for it in this country a larger share of patronage than perhaps was ever conferred upon any other book of surgery; while its translation into the French, German, and Italian languages, and several republications of it in America, may be taken as proofs of its being deemed worthy of considerable notice in various other parts of the world. Speaking of the opinion, entertained of this compendium of surgical knowledge in the United States, Dr. Reese observes:—"It has long been esteemed a standard work, is adopted as a text-book in our Universities, Colleges, and Schools of Medicine generally, and finds a place in the library of every surgeon in the country." (*Pref. to Amer. Ed.*) The diligent and enlightened Germans were not only the first to undertake and complete a translation; they have bestowed still greater attention upon my humble endeavours to promote the cultivation and diffusion of surgical science; for they have followed up their translation by a series of well-executed engravings, expressly designed to illustrate the nature of the diseases, accidental injuries, and curative methods, treated of in this Dictionary. (See *Chirurgische Kupfertafeln,* 4to. Weimar, 1820—1829.) Of these valuable plates, the publication of which I regard as an honourable compliment to my surgical labours, many numbers have been brought out at an extremely moderate price; and it is with real pleasure that I recommend them to the notice of every surgeon who is a German scholar, as being one of the most useful collections of surgical and pathological plates ever offered to the profession.

In preparing this edition, which comprehends an account of all the principal modern improvements in surgery, I have conscientiously endeavoured to deal fairly and impartially with every individual, whose name I have had occasion to mention, or whose suggestions form subjects of consideration in the ensuing pages. My aim has been truth, wherever I could find her; and in every situation, where any glimpse of her beautiful figure presented itself, I have ardently courted her, regardless of the name, school, or country on which she might deign to shed her glory. By steadily adhering to this principle; by zealously marking what the book of nature and the field of experience unfolded; by renouncing all obsequious submission to every other kind of authority; and by taking the liberty of sometimes thinking and judging for myself; I trust, that the most likely plan has been adopted of maintaining the character of this book, and raising my own reputation.

In particular it affords me peculiar gratification to have had an opportunity, in this seventh edition, of bringing under the notice of British surgeons the meritorious transactions of their brethren in the United States, where the same zeal for the advancement of surgery, and the same just estimate of its value to society, are exemplified as in the mother country. In operative surgery, the surgeons of no nation have exceeded them in decision, coolness, enterprise, and boldness; and however doubtful I may individually be, respecting the real good likely, on the whole, to result to mankind from certain extraordinary achievements with the scalpel, which, as will be seen in the course of this work, have been performed in America, I give the surgeons of the United States, as I do to many surgeons in my own country, France, and Germany, who are smitten with the love of similar proceedings, the credit of being actuated by the zealous hope of being able by such means to extend the efficiency of surgery to cases of the most desperate kind. Far be it from me to censure, or discourage, these performances, if kept within the limits prescribed by reason and moral considerations, and not applied to examples in which the chances of a natural cure, poor as they may be, are at least equal to those presented by the operation itself, and which, if it fail, is sure to bring the life of the sufferer to an abrupt termination. Here a very severe and perilous operation, at all events, can only be justified on the principle, that the agony which the patient is enduring from the disease, and must continue to endure, if the operation be not attempted, makes his life, in this condition, of no real value. Let me hope, that the enthusiasm for operations (the art of performing which may be acquired by any one who has nerves of the right kind, and is a good anatomist, in a very short time) will not lead to the neglect to become acquainted with the more common duties of the surgical practitioner; nor to the omission to study profoundly all the leading rules and principles of surgery. It is likewise to be hoped, that it will not occasion any forgetfulness of the vast importance of medical surgery, by which the necessity for mutilating the human body may often be completely obviated. It is also my sincere prayer, that the present increasing rage for operations may never throw into the shade the various physiological and pathological views of the whole subject of surgery, without which it would immediately descend to the rank of only a mechanical art, instead of meriting the name of a science.

This edition will not only be the means of diffusing the knowledge of what has been done in operative and other parts of surgery by European and American surgeons, but it will prove that, however right Dr. Reese may have been in complaining of my not having formerly done full justice to the surgeons of the United States, it was not from any desire on my part to keep their transactions concealed, but simply from the fact, that I did not then possess the information, that has since reached me, of their praiseworthy exertions.

In bringing out this Dictionary in its present state of improvement, I beg to declare myself deeply indebted to the surgeons of almost every country, but especially to those of Great Britain and Ireland, France, Germany, Italy, and the United States. For many valuable communications I feel obliged to Sir Astley Cooper, Sir Benjamin Brodie, Mr. J. G. Crosse, M. Velpeau, Professor Regnoli, my colleague Professor Quain, and my esteemed and talented pupil Mr. Thomas Morton, of University College. The doctrines and practice of the celebrated Dupuytren I have explained and considered with all the attention which so high an authority deservedly claims; and I will add that, as many of his observations appear to me the best ever delivered on certain parts of surgery, the introduction of them into this extensively circulated book may be an important advantage to the profession and the public. The following estimate of the character of this Dictionary is from the pen of Dr. Reese: —

"As, in every species of human science, our highest attainments are but an approximation towards perfection, so in the science of surgery, each succeeding year demonstrates, that all that is known of the principles, or practice of our art, is but the prelude to still higher exhibitions of science and skill, alike honourable to the profession, and valuable to the cause of humanity. To condense and arrange all the novel and interesting facts, which clinical experience is furnishing, and upon which alone the edifice of true science can be erected, is a task worthy of the immense labour which Mr. Cooper has bestowed on each succeeding reprint of his Dictionary, and one to which he has proved himself entirely adequate. The extensive and multiplied resources, to which he has access, furnish him with facilities possessed by few; and in availing himself of these, he has exhibited an industry, and, for the most part, an impartiality, worthy of all praise."

According to my usual plan, I annex the notice of a few things, which were either inadvertently omitted in the articles to which they relate, or communicated to me after such articles had been printed.

S. COOPER.

7. Woburn-Place, Russell Square.
Nov. 12. 1838.

ADDENDA.

AMPUTATION. The following notice I find in *Reese's American edition of this Dictionary.* The proposed operation, I apprehend, will be objected to, as far more painful and tedious than the flap-amputations, commonly performed at University College Hospital: —

[A mode of amputating the thigh with two flaps (observes Dr. Reese) was proposed a few years since by Professor J. B. Davidge, of the University of Maryland, which combines several important advantages.

The first incision is made with the large knife on the outside and inside of the thigh through the integument, so as to surround the limb, with the exception of an inch or more in the centre above and below. The surgeon having calculated the size of the flaps required, which are to be as long as the semi-diameter of the limb, makes with a scalpel a second and third incision through the skin, in form of the letter V, commencing above the centre of the space left vacant on the superior and inferior surface, and continued until its diverging extremities reach the ends of the semicircular cuts first mentioned. The flaps of integument are then dissected back until they equal in length a little more than the semi-diameter of the limb, to allow for the retraction that may occur. A circular incision is then made through the muscles down to the bone with the large knife. The bone is then denuded for an inch or two, the retractor employed, and the bone sawn off at the edge of the divided flesh. The arteries are then secured, the muscles drawn down, the ligatures so arranged as to come out of the superior and inferior angles of the wound, and the flaps are brought together and kept in place by adhesive straps, supported by a cross bandage, roller, &c. By this amputation the bone is cut off an inch or more within the actual face of the stump, and the flaps of integument having the angle cut out above and below, do not present that unnecessary and inconvenient lump or puckering, formed at the angles after the common circular amputation. I have seen this operation performed by Dr. Davidge and others, with singular success. The stump heals by the first intention, without any of the delays which are often encountered with the common flap-operation; and I prefer it for the arm as well as the thigh, unless the limb be much emaciated. *Reese.*]

In flap-amputations of the leg, it appears to me, that the anterior flap of integuments should be made longer, and the posterior flap of the integuments and muscles of the calf, about one

means, the front of the tibia will be better covered, and the frequency of exfoliation diminished; while there will also be the advantage of the surface of the wound being considerably lessened below, where matter is disposed to form and lodge.

In the United States, amputation of the upper jaw was first performed by Dr. David L. Rogers, of New York. (See Osteosarcoma.) Amputation, or exsection of the clavicle, was there performed for the first time by Dr. Mott. in 1829. In the twenty-first volume of the *Med. Chir. Trans.* are the particulars of a similar operation executed by Mr. Travers. Other cases I have noticed in the article Bones, excision of. In Mr Travers's case, the operation was performed on account of a tumour of the clavicle. "A crucial incision was made through the integument and platysma myoides, one limb of which was nearly in the line of the clavicle, and the other at right angles; and the flaps and fascial coverings successively dissected down to the external basis of the tumour. The pectoralis and deltoid muscles were then carefully detached from their clavicular origin, avoiding the cephalic veins, and the fibres of the trapezius and cleido-mastoid muscles divided on a director. One considerable vessel, in the situation of the transversalis humeri, required a prompt ligature. The circumference of the tumour was now well defined, though it was found to be firmly imbedded, and adherent on its posterior aspect. Disarticulation of the scapular extremity of the bone was next effected without difficulty; and the mobility, thus communicated to the mass, facilitated the completion of the operation. A director was now worked beneath the bone, as near to the sternal articulation as was practicable, and, with a pair of strong bone nippers, thus introduced, it was completely and clearly divided. The subclavius muscle, and a part of the rhomboid ligament, were now detached from the tumour, and the mass being well raised by an assistant, while the edges of the wound were kept wide apart by metallic retractors, the cervical prolongations of the tumour were separated from their remaining connections by a few touches of the scalpel, without injury to the subclavian vessels." The loss of blood did not exceed twelve ounces. The case terminated so favourably that there was scarcely any falling forward of the shoulder, nor any restriction of the motions of the arm. The young gentleman elevates it perpendicularly over his head, extends it horizontally, carries and rotates it behind the trunk, and performs the same extent and variety of circumduction, and with equal promptitude and arm. The production of bone, from the truncated sternal extremity of the clavicle, extends at least two inches, and terminates beneath the centre of the cicatrix in a firm ligamentous band, adherent to the skin. (See *Med. Chir. Trans.* vol. xxi. p. 135, &c.)

ANCHYLOSIS. On this subject, I meet with the following observations in *Reese's American edition of this Dictionary* :—

[A highly interesting operation has been performed by Professor Mott, for the cure of permanent anchylosis, or rather " immobility of the lower jaw," which had existed for ten years. A report of this case is published in the *American Journal* for Nov. 1829; but as the disease and operation are of so novel and interesting a character, Dr. Mott, at my request, has politely furnished me with the following description of the case, which cannot be unacceptable to the profession, and I therefore insert it here :—

" A young man, twenty-one years of age, from North Carolina, called, with the lower jaw almost immoveably fixed to the upper. No motion in a downward direction could be discovered, nor was the most powerful effort with the hand upon the chin able in the slightest degree to alter its situation. He had been in this deplorable state for ten years. Unable to chew a mouthful of food, or even open the jaws for its reception, his food had to be introduced through a small opening, occasioned by an irregularity of the bicuspides teeth on the right side. On the left side, just within the angle of the mouth, a very firm band, of more than ligamentous hardness, was to be seen and felt, reaching from this point along the alveolar ridge to the coronoid process.

" Along the whole course of this adhesion to the gum of the lower jaw, there was not a vestige of a tooth, and he stated that from this part the jaw had been formerly separated, with the teeth attached to it. This morbid adhesion had been several times freely divided; it was cut from within the mouth in different directions, but never permitted the least motion of the jaw.

" From the circumstance that he could give a little lateral motion to the jaw, I thought that his mouth might yet be opened, and the deformity removed. I then made an incision from the angle of the mouth on the left side through the cheek, nearly to the coronoid process, dividing the firm cicatrix within completely. The jaws being relieved by dividing all the adhesions between them, a piece of very broad tape was placed between the teeth by a probe and spatula, and tied some distance below the chin. To the loop thus formed I applied all the strength I could command, but not the least yielding of the jaw could be discovered.

" I then applied the principle of the screw and lever, by an instrument prepared for the purpose, composed of two steel plates about three inches in length. When applied to each other, they were of a wedge-shape. To the large end was attached a screw, which, when turned, caused the thin extremity of the plates to expand. This instrument enabled me to open the mouth completely.

" With considerable difficulty this vice was insinuated between the range of teeth on the left side, resting along their whole course. It was then expanded, by turning the screw; and such was the report that attended the yielding of the lower jaw, that several present thought it was broken, but the noise was like that attending the laceration of ligaments rather than such as attends the fracture of a bone. The mouth was immediately opened to a sufficient extent.

" The wound was closed with the interrupted suture and adhesive plaster; to prevent the adhesion of the cheek to the jaws internally, pieces of sponge were interposed. The patient was enabled to chew his food, and to converse and articulate distinctly, as the result of the operation; and he entirely recovered."

Dr. Mott has since repeated the operation, with the same success, on a gentleman from Louisiana.

In the *North Amer. Med. and Surg. Journal* for April, 1828, Dr. J. Rhea Barton has published a most successful operation performed on a case of anchylosis at the hip-joint, attended with very great deformity, after it had existed for more than eighteen months. The object of the operation was to substitute an artificial joint for the loss of the natural articulation at the hip, and it is most honourable to Dr. Barton, and alike gratifying to the profession and to humanity, to record, that it has been most completely successful. An abridged account of this novel and most interesting exhibition of consummate surgical skill is given in the Appendix to the late Philadelphia edition of *Cooper's First Lines*, of 1828. It was performed on a sailor at the Pennsylvania Hospital, in Nov. 1826. (See Anchylosis.)

In Dr. Francis's edition of *Denman's Midwifery* is described a peculiar affection of the hip-joint, in some respects novel and important. It is in effect an anchylosis, and is denominated " a displacement of bone without fracture or dislocation," inducing a morbid change in the form and cavity of the pelvis, such as might wholly defeat the process of natural labour. The patient, an adult subject, fell on the right hip; the injury done to the external parts was comparatively slight; but an inflammatory action took place in the bottom of the acetabulum, which caused total absorption of the bone, and the protrusion of the head of the thigh-bone itself into the cavity of the pelvis. Nor was the diseased action limited to these changes; large deposits of osseous matter were made within the pelvis surrounding the absorbed acetabulum; and the head of the thigh-bone was by the same material augmented to more than double its original size. The neck of the bone and also both trochanters were considerably increased in bulk. The capacity of the pelvis was diminished about two inches in its superior and lateral portion.—*Reese.*]

ANEURISM. With respect to Brasdor's method of operating for certain aneurisms, Dr. Reese introduces the annexed observations:—

[In the *Medical Repository* for 1823, vol. vii. No. 4. p. 404., Dr. David L. Rogers, then resident surgeon of the New York Hospital, has published a paper, entitled, Observations on Aneurisms, in which this operation is contended for as being applicable to the carotid artery, and to this alone. He is wrong, however, in giving the projection of this operation to Desault; for, although it is described in his works by Bichat, yet it was proposed by Brasdor. And as this seems to be a controverted point, I have taken some pains to trace the progress of this improvement, and find that the operation was first proposed by Brasdor nearly half a century ago, so that the projection of the plan unquestionably belongs to him. Bichat next gave directions for its performance in his edition of Desault, and here the error of Allan Burns probably originated, which has been since repeated by so many. Deschamps was the first who performed the operation in a case of femoral aneurism; then Sir A. Cooper repeated it on the external iliac; then Mr. Home's case occurred: all of which were unsuccessful. Mr. Wardrop's first trial of it for a carotid aneurism was made in 1825, by tying the vessel on the anti-cardial side of the sac, with complete success. Mr. Wardrop's second trial was not so fortunate, and, as will be perceived, it is questioned whether the artery was tied at all. Mr. Lambert next operated (as will be seen in this article) without success; and Dr. Bushe's and Dr. Evans's cases were the only successful instances I can find, so that the former of these is the second; and the latter the third, in which Brasdor's method has succeeded. Dr. Mott's case is therefore the fourth successful instance on record, and certainly the only one in which it has been attempted in America. So much light has been elicited on this dark subject by the cases alluded to, that there can be little doubt that the operation on the distal side of the aneurism will now rescue from the grave many valuable lives, which would therwise be lost to the world, and abandoned as beyond the resources of our art.—*Reese.*]

Subsequently to the period when the article ANEURISM was corrected, Mr. Liston, in a case of subclavian aneurism, situated very close to the outer edge of the right scalenus anticus, took up the right subclavian and right carotid at their origins; by which measure it was hoped, that the innominata would become completely plugged up with coagulated blood, and the former vessels have a better chance of being permanently closed, than if a ligature had been applied to the much larger vessel, the innominata itself. The suggestion was made by Mr. Quain. In fact, previously to the patient's death from hemorrhage, on the tenth day after the operation, the innominata became perfectly blocked up with solid blood; the ligature had come away from the carotid, and was found lying loose in the wound, with the two orifices of the artery above and below separated by an interval of more than an inch, and permanently closed. The ligature on the subclavian had not separated, but the root of that vessel, on the side towards the heart, was closed; and the hemorrhage had taken place from an ulcerated opening in the portion of the artery on the distal side of the ligature. My friends, Sir Astley Cooper, Mr. Vincent, and some other surgeons of great experience, have noticed that, when secondary hemorrhage occurs, after operations for aneurism, it is most frequently produced by ulceration of the vessel on the distal side of the ligature.

The following passage I find in the *American edition* of this work:—

[In cases of aneurism of the thigh, it is not always practicable to decide with absolute certainty whether the disease is situated in the femoral artery, or in the *profunda;* and even when it obviously originates with the former, the latter is often deeply involved, particularly when the disease has been of long standing. Many unsuccessful cases have been reported; and I know of one which has failed in the hands of a distinguished surgeon, the aneurismal tumour still remaining, although the femoral artery was tied above the tumour. In this case the disease is, no doubt, seated in the profunda.

Many surgical writers and teachers have inculcated the doctrine, that, when the aneurism is situated in the thigh, the ligature must always be applied *below* the bifurcation, lest the circulation of the limb should suffer. A distinguished surgeon of Philadelphia preferred opening the sac of a femoral aneurism, and applying his ligature below the profunda, rather than venture to tie the artery higher up. The operation failed, however, and the tumour still remains. That such fears are wholly groundless, may be confidently asserted from analogy, furnished as we are with the knowledge that the innominata, the common iliac, and even the aorta itself, may be obliterated, and yet the anastomosing vessels continue the circulation. But Dr. Whitridge, an accomplished surgeon of Charleston, S. C., has afforded a demonstration in a case of aneurism in the thigh from a gun-shot wound, in which he tied the femoral artery just below Poupart's ligament, and of course above the point at which the profunda goes off. This case has been completely successful, and the patient recovered without any sensible interruption in the circulation, and without any untoward symptoms.

The cases in which the femoral artery divides high up, which Professor Godman has shown are by no means unfrequent, may account for the occasional failures of this operation, and should not be lost sight of by the judicious surgeon. As a general rule, however, applicable to all other cases, when the aneurism is situated immediately below the bifurcation, and in the vicinity of the profunda, it is safer, and also better surgery, to apply the ligature above. The action of the profunda may endanger the success of the operation, and the most profound surgeon may sometimes mistake the seat of the disease. — *Reese.*]

Besides the examples of ligature of the internal iliac, referred to in the present work, I find another, in which this operation was successfully performed, for the cure of a gluteal aneurism, by Professor White the younger, of Berkshire Med. Institution, in the United States. This case, which is alluded to by Dr. Reese, is published in the second number of the *American Journ. of Medical Science.*

According to Dr. Reese, Professor Bushe tied the common iliac, in a child less than two months old, for a congenital aneurism of one of the labia. The child recovered from the operation, but perished a few weeks afterwards from abscesses of the knee-joint.

With regard to axillary aneurisms, it appears that Professor Gibson (to whom I am under great obligations for several favours) cured a case of this description, occasioned by the reduction of an old luxation of the humerus, by tying the subclavian artery. (*American Journ.* vol. ii. p. 136.)

The particulars of Mr. Perry's example of varicose aneurism in the thigh are published in vol. xx. of the *Med. Chir. Trans.* When I saw the patient with Mr. Perry, in the St. Mary-le-bone Infirmary, I expressed my belief. that the symptoms indicated a communication between the femoral artery and vein. I mention this, as it is not stated in Mr. Perry's paper.

On the subject of carotid aneurism, Dr. Reese informs us, that the late Dr. Bushe tied the common carotid for the cure of an aneurism, situated in the fauces, with complete success; and he adds, that "Professor Pattison, when resident in Baltimore, cured an immense aneurism of the internal maxillary by tying the trunk of the carotid. I witnessed this operation, and saw the successful result." (See *Amer. edit. of this Dict.* part i. p. 140.)

From some remarks, contained in the article ANEURISM, it will be seen, that apprehension is sometimes entertained, that, though one carotid may be tied without dangerous disturbance of the functions of the brain, the ligature of both carotids would produce such consequence; yet Mr. Liston's late operation on the roots of the right subclavian and carotid, proves that suddenly cutting off the direct supply of blood to the brain, through the carotid and vertebral arteries of one side, does not have this dreaded effect.

In relation to the practice of tying an artery on the distal side of an aneurism, Dr. Reese observes, that "It affords me high gratification to record, that Professor Mott, of New York, has lately performed this operation for the first time it has been attempted in America, by tying the carotid artery for aneurism of the arteria innominata, involving the subclavian and root of the carotid. This is the first time in America in which aneurism has been treated by tying the artery on the anticardial side of the tumour. The report of the case, and its successful result, is contained in the *American Journal of the Medical Sciences,* No. x. for February, 1830. Since that report was published, the patient has died, and the tumour having been removed, fully establishes the success of the operation. I have had an opportunity of examining the preparation, and found the carotid entirely obliterated and impervious above the aneurismal sac, although the ligature was applied very high on that vessel. The death was occasioned by the displacement and distortion of the trachea and larynx, which are seen lying on the side of the neck, and in no wise connected with the operation, but was the consequence of the long existence of the disease before the operation was submitted to." — *Reese.*

Since the article aneurism was printed, the arteria innominata has been tied by Mr. Lizars; but with the same unfortunate success, as has followed all other examples of this operation. Under these circumstances, ought the practice to be continued? I think not, especially with the evidence in favour of tying the carotid. See ANEURISM.

ANUS, ARTIFICIAL. Alf. Velpeau, *Mém. sur les Anus contre Nature dépourvus d'Epéron, &c.*, 8vo. Paris, 1836.—In this tract, several cases are detailed, explaining a new operation for such cases. In one of them, in which M. Velpeau was assisted by Dr. Mott, the whole fistula was inclosed within an ellipsis, in order to accomplish the excision of it by means of a double semi-lunar incision, but extending obliquely from the sides towards the centre, and so as not to implicate the bowel, or, at all events, its mucous membrane. M. Velpeau then introduced four sutures, two lines apart, with the precaution not to let them pierce the abdomen or the intestine. Then an incision, two inches and a half long, was made through the skin, subcutaneous cellular tissue, and aponeurosis of the external oblique muscle on each side, and about twelve or fifteen lines on the outside of the wound. The parts having been well washed, the threads were tied, and a dossil of lint placed in the lateral wounds to keep their edges asunder, until the other dressings were applied. Thus M. Velpeau's plan is to leave the deep or intestinal circumference of the fistula untouched; to pass the threads without touching the bowel; to make a long incision on each side of the fresh cut surface of the fistula, an inch or two from it; to apply dressings which make no pressure on the abdomen; to give an aperient every evening; and to restrict the patient to low diet.

ARTERIES.—"Professor Jamieson, of Baltimore, in a valuable paper on traumatic hemorrhage, published in the *American Med. Recorder* for January, 1829, has detailed a number of experiments performed on inferior animals, in some of which he passed a seton through large vessels, with a view of obstructing their circulation, and thus effecting their gradual obliteration. His success was certainly encouraging; and Dr. Webster, of Philadelphia, has repeated these experiments with similar results. The latter gentleman, in the late Philadelphia edition of *Cooper's First Lines,* has introduced some highly interesting and practical remarks on this subject, in a note on the subject of aneurism; to which reference may be had, as containing hints of the most invaluable importance.

"Future experiments, however, will be necessary to enable the surgeon to arrive at definite conclusions on this most interesting subject." — *Reese.*

ARSENIC. In the last edition of this work, the remarks on this deleterious substance were less copious than in the present. Dr. Reese, in his notice of what I formerly stated, observes "There can be little doubt, that *arsenic* is the basis of the active ingredients of most of the popular nostrums of the day which are set forth in our public papers as infallible remedies for the cure of cancerous affections, as they are termed; and hence the manifold evils which we often witness from such practice. So long ago as in 1786, Dr. Rush favoured the public with an exposition of the nature of the famous cancerous powder of Dr. Martin; its base was arsenic; though, like the specifics of our own time, it was alleged to be of a vegetable nature. The consequences arising from applications of this character might be noticed at greater length than our author has seen fit to do; and the caution to be deduced from facts of this sort might operate more forcibly if they were better understood. The external application of arsenic ought to be had recourse to only after the severest scrutiny into the peculiar character of the case and constitution affected. Even in small quantities it has produced apoplexy, mental aberration, organic lesion of the stomach, paralysis, loss of motion, enlargement of the joints, fatal petechiæ, &c. Arsenic, in fact, may be enumerated among that class of poisons which induces nearly the same effects externally applied as well as when taken inwardly. The experiments of Brodie, as well as those of other philosophers, demonstrate, that its influence on the system is no less rapid and dangerous when had recourse to as an external application to denuded surfaces than when applied directly to the stomach. Another peculiarity of its action deserves also farther to be stated: according to Professor Francis (*Lectures on Forensic Medicine*), in *some cases*, even while favourable anticipations from the operation of this powerful agent locally applied are indulged, of a sudden the general health yields, and death *ensues rapidly and unexpectedly;* an occurrence of much consideration in the investigations of the juridical physician." (*Reese.*)

BONE, ATROPHY OF. *Obs. on some of the Forms of Atrophy of Bone, by Thomas Blizard Curling.* — Local atrophy is generally the result of pressure, or friction, as exemplified in the effects of aneurism, and other tumours on the bone, and in the change taking place in the size and shape of the head of the dislocated humerus, if not reduced. Of such alteration, there are some excellent specimens in University College Museum. Mr. Curling notices also the local atrophy of bone from mechanical injury, and refers to the two thigh-bones figured by Cheselden, in his *Osteographia*, taken from the body of a soldier, who had been shot in the right groin, and died soon afterwards of dropsy. The right femur is represented as much wasted, and to have been less than half the weight of the other.

The author likewise adverts to the atrophy of bones consequent to a suspension of their functions; and to that induced by deprivation of the nervous influence, as sometimes exemplified in cases of injury of the spinal cord. Mr. Curling adduces instances of these facts, and refers to a case, recorded by Mr. Travers, in which the union of a fractured leg, that was paralysed from a fracture of the lumbar vertebræ, failed to proceed, whilst a broken humerus in the same patient united perfectly in the usual period. (*On Constitutional Irritation*, vol. ii. p. 436.)

Although the ligature of the femoral artery in a fracture of the leg complicated with hemorrhage, is well known not to interrupt the nutrition of the bone, or the union of the fracture (see FRACTURES; and *Travers, Op.* cit. p. 436); yet, it appears from Mr. Curling's investigations, that, if the supply of blood to a bone by its nutrient artery be obstructed, a species of atrophy will ensue. Thus, in the thigh-bone, if fractured below the entrance of this artery, the walls of the portion of such bone below that point will be found thinned, and the cancelli expanded. Such change, however, is not observed in bones recently fractured, nor in those long united, nor in bones fractured during the period of growth. Mr. Curling concludes with some interesting remarks on fractures of the neck of the femur. (See *Med. Chir. Trans.*, vol. xxi.)

BRONCHOCELE. In the American edition, which came into my hands after most of the articles in the letter B had been printed, the following passage occurs: —

[The prevalence of goître in different parts of the United States is stated by our author, and several American writers have described the disease as existing in various parts of our country, whose geological features very widely differ in many respects. In Vermont, in New York, in Pennsylvania, and Ohio, the disease is by no means unfrequent. Professors Barton and Gibson, of Philadelphia, have communicated many valuable observations on this disease. More recently, Professor Francis, of New York has made a series of observations on goître as it appears in the western part of the state of New York. From the communication with which he has politely favoured me, the following abstract is prepared. I may add, that, agreeably to the facts deduced from the changes which our country undergoes in the progress of improvement, we have the strongest reasons to infer that, as the climate and cultivation are meliorated, the instances of the existence of this disease will doubtless become less frequent.

However frequent cases of goître may have formerly been in the state of New York, the fact is certain, that they are much more rare at present. Even the representations of the late Dr. Dwight, relative to the great prevalence of the disease, though among the most recent with which we have been favoured, are to be received with allowance. That in particular portions of our western country, repeated examples are to be found, may be known by any accurate observer. But "in the village of Utica (says Dr. Francis), which contains between 4 and 5000 inhabitants, no case of bronchocele could be pointed out, and this village occupies the site of old Fort Schuyler, on the Mohawk, the vicinity of which has been referred to as the spot where goître was peculiarly prevalent. I am strengthened in the accuracy of this statement relative to the almost total disappearance of goître in this neighbourhood, by the testimony of Dr. Coventry. A similar remark may be made with regard to the former frequency of the disease throughout the extensive region from Utica to Buffalo. The late Uriah Tracy, in his excursion through this country some years since, was led to believe that bronchocele prevailed in the old settlements as well as the new, and thought it incidental to the country at large. In my late visit, I made special inquiry as to the present condition of the health of the inhabitants, and am persuaded that the instances of goître are much more rare, than at the period of Mr. Tracy's observations. The number of cases, which came under my notice during the tour, were twenty-three. These were at Herkimer, Manlius, Syracuse, Onondaga, Batavia. Williamsville, and Buffalo; and I saw more cases in the neighbourhood of Buffalo than at any other place. In other parts of the state the disease may be seen, particularly in the county of Alleghany."

To assign a satisfactory cause for this disease is difficult, perhaps impossible. Dr. Barton has endeavoured to show that goître and intermittent and remittent fevers have one common origin, and argues this opinion from the simultaneous prevalence of these diseases, from the frequency of glandular affections where intermittents abound, and from the opinion that persons afflicted with goître are exempt from intermittents, though in the midst of these diseases. Dr. Coventry inclines to ascribe it to drinking water impregnated with alum. Dr. Dwight advocates the more current opinion, that these affections originate from the lime contained in the water drank in those regions. Dr. Francis ascribes the production of the disease chiefly to humidity, and hence it prevails most in the vicinity of lakes and rivers where vegetation abounds. He says, it increases with the rainy seasons, and is diminished when the weather becomes cold and dry, and hence argues the reason of its disappearance as the country becomes cleared. He however does not altogether reject the agency of certain waters in aggravating, if not producing the disease.

Of the twenty-three cases examined by Dr. Francis, two only were in male subjects, and one of them an adult Indian, in Niagara county. He saw it in an infant but a few months old, and he subscribes to the opinion that it often depends on constitutional causes, and is sometimes hereditary.

In Oneida county, Dr. Francis learned that goître prevailed among sheep, and Foderé gives us a similar fact of its occurrence among dogs. The doctrines of Hunter and others, in considering the sexual functions connected with this disease, are sustained by its greater prevalence among women, and also according to Dr. F., by some well-known facts connected with parturition.

Dr. Coventry has removed several cases of goître by the simple expedient of the patient wearing the muriate of soda about the neck. The recent plan of Mr. Holbrook, of employing steady pressure, has been tried in this country with some success. The efficacy of burnt sponge has often been seen, but instances of its failure are not unfrequent. The iodine has been used of late years with the best effects, and Dr. Congdon, of Buffalo, has reported its entire success in a number of cases.

Dr. Francis informs me, that in a subsequent journey through this state, he found a number of interesting cases, and that the disorder in every instance afflicted the female sex, and, in eight or ten cases, it was obviously associated with the function of menstruation and parturition. The left portion of the gland was most frequently the seat of the disease, but in no instance was it connected with idiotcy. He reports one instance of the entire cure of a formidable case which occurred in a young married female, who upon leaving the neighbourhood of Catskill, and removing to the southern states, after a residence of three years, was entirely relieved of her goître.

I can add my own testimony to the value of the iodine, having witnessed its success in a number of cases, which had resisted the other remedies ordinarily employed.

The operation of removing the gland by the knife has been performed in this country with success, but is seldom advised, and will not often be repeated.—*Reese.*]

BRONCHOTOMY. Into the article on this operation, as it stood in the 6th ed., Dr. Reese introduces the annexed remarks :—

[There is no inconsiderable diversity of opinion among eminent surgeons as to the propriety of performing bronchotomy in cases of croup; and those who oppose the operation very plausibly allege, that in the membranous stage of croup no advantage can result from the operation, however favourable the condition of the sufferer may be in other respects. The views of the celebrated Cheyne would seem to put beyond doubt the inutility of the operation as already noticed by our author, because it is inadequate to the removal of the artificial membrane which is effused in the advanced stage of cynanche trachealis. I am not prepared from my own experience, wholly to decide the difficulty. We have evidence sufficient, I think, to justify an occasional recourse to this exercise of surgical skill; but there is still another means of relief, not stated by our author, that may fitly be introduced here, which will often render this operation unnecessary, even in those cases in which it is confidently recommended by some, and certainly ought to be fully tested before we avail ourselves of so doubtful a remedy.

In that stage of croup which has been aptly termed the fatal stage, from its so generally proving such, and which is characterised by the existence of the membrane, the vitriolic emetics have been introduced with decided success.

This practice was first introduced by Professor Francis, of New York, in 1813; and since the report of his success, has become very generally adopted in this country, and with singular success. I have now in my possession a specimen of an entire membrane lining the trachea, detached and thrown up under the powerful emetic action of the blue vitriol, after venesection, blisters, calomel, polygala, senega, and all the approved remedies, had been tried ineffectually.

I regret that the limits assigned me preclude my inserting the interesting detail of the cases reported by Dr. Francis, in his valuable paper published on this subject, and have to content myself with referring to the *New York Med. and Phys. Journ.*, vol. iii. p. 58. *et seq.*, only remarking, that in the almost hopeless state in which the sequela of inflammation are so threatening, *calomel*, in large doses, is among the most efficient auxiliaries to which we can have recourse. "After the existence of the membrane," observes Dr. F., "and when the powers of life are on the wane, it is a judicious and sometimes an available resource;" and he admits, that in the cases in which he found the vitriolic emetics successful, their agency was probably favoured by that potent mercurial.

I find a similar practice has been adopted by Dr. Hoffman, of Vienna, who first used the vitriolic emetics in 1820; and so highly does he estimate them, that he declares their action to be a *specific* in this stage of croup. This is unquestionably saying too much in their behalf; yet certainly they are entitled to high consideration, and ought never to be omitted in these almost hopeless cases.—*Reese.*]

CÆSAREAN OPERATION. By Mr. Knowles, of Birmingham.—Case of deformity of the pelvis from mollities. Incision made in the linea alba, and ten inches in length. The child and mother both saved. (See *Trans. of Prov. Med. and Surgical Association*, vol. iv. p. 376.) She was 36 years of age, and had previously been delivered of several children.

Professor Gibson, of the University of Pennsylvania, has performed this operation, a second time, with success upon the same woman, who recovered without a single bad symptom, and eight weeks after the operation, the infant was in excellent condition. (See *Philadelphia Med. Examiner.*) For an account of this woman's first labour, in which cephalotomy was performed, see *North American Med. and Surg. Journ.*, No. xxiv. Oct. 1831.

In the last American edition of this Dictionary, I find some interesting matter, relative to extra-uterine conceptions. The following case is pronounced by Dr. Reese to be unique in its kind. It occurred in the practice of Drs. Cotton and Harlow, of Georgia, and was communicated to Professor Francis, of New York. The subject was a negro-woman, aged 30 years. On the night of the 23d of Jan. 1819, she was taken in labour. Her labour pains ceasing, she was attended for a few days for dropsical symptoms. On the 4th of February, she was again taken in labour, but the pains soon ceased. In five weeks she died. On the *post mortem* examination, Drs. Harlow and Cotton first drew off from the abdomen three and a half gallons of turbid offensive fluid. On opening the abdomen, the first thing that presented itself was the child extended across the abdomen; its head in the right, its feet in the left, hypochondriac regions; its back immediately behind the mother's umbilicus. The child was as large as either of these practitioners had ever seen at birth, and perfectly formed. *The funis was of the usual size, about six inches in length, and inserted into the fundus uteri, without the intervention of a placenta.* The uterus was about the size of an orange; its coats very much thickened and indurated, with a small quantity of a thin glassy fluid within its cavity. The abdominal viscera were all diseased, save the bladder. The liver retained its original shape and position, but looked more like a mass of glue than organised animal matter. The bowels adhered together in one uniform mass from the stomach down to the rectum. (See *New York Med. and Physical Journ.* vol. i.)

"The case of extra-uterine fœtus, in which Dr. Mac Knight, of New York, operated with success, is often referred to. (See *Lond. Med. Society's Trans.*, vol. iv.) This interesting case (says Dr. Reese) confirms the views of those who believe in the entire production and perfection of the human fœtus *extra uterum*. (*Thacher's Med. Biography.*) But, even this operation is not entitled to the epithet Cæsarean, and therefore does not detract from the claims of Dr. Richmond," who in 1827 performed the first operation in the United States of opening the uterus itself; and this with success. (See *Western Journ. of Med. and Physical Sciences* for April, 1830.) In America, gastrotomy has been performed for the removal of extra-uterine fœti several times with success. Mr. Wm. Baynham, of Virginia, as early as 1791, performed this operation, and by removing the fœtus, which had lain in the abdomen ten years, preserved a woman who was sinking into the grave with hectic fever. In 1799, he repeated the operation on a servant woman of Mrs. Washington, Fairfax county, Virginia. (See *New York Med. and Phys. Journ.* vol. i.) In the same work, Dr. J. Augustine Smith, now Professor of Anatomy in the University of New York, has published a case, in which he performed the same operation in 1808 with the most satisfactory result.

In the *New York Med. and Phys. Journ.* vol. ii. 1823., are some cases of Cæsarean operations: two of them were self-performed; and the other accomplished by an ignorant female accoucheur. The recoveries must therefore be considered as extraordinary escapes. One of these cases is that reported by Mr. Duncan Stewart. (*Edinb. Med. Essays*, vol. v.); another is that recorded by Moseley (*On Tropical Diseases*). Dr. Richmond of Newton, Ohio, reports a successful case of Cæsarean operation, performed in 1827. The mother recovered in four weeks. The necessity for it arose from malformation of the os lincæ and vagina. This is the first and only instance of the successful performance of the Cæsarean section in the United States. (See *Reese's Amer. ed. of this Dictionary.*)

CLUB-FOOT. In the article TENDONS, I have noticed the operation of dividing the tendon of Achilles, as a means of restoring the foot to its proper position in certain examples of this deformity. A great deal has been published on the subject of machinery for club-feet; but as Dupuytren justly observes, the history of such cases was left very defective in consequence of no anatomical examination having been made of the parts affected. In the most frequent congenital distortion of the foot, termed by the ancients *varus*, the point of it is turned inwards, and the dorsum downwards, so that the patient walks on its outer edge, and sometimes even upon the dorsum itself. The second much less frequent variety is that called *valgus*, in which the foot is turned outwards. There is also a third variety, in which the point of the foot is drawn backwards, and the position of the whole foot is so reversed, that the patient walks entirely upon the instep. Dupuytren looks upon a dislocation of some of the bones of the tarsus, together with a subsequent change in the arrangement of the ligaments and muscles, as the essential cause of the deformity. All the external appearances of club-foot were well described by Scarpa; but, according to Dupuytren, no writers have called attention to the affection of the nutrition of the limb, and its atrophy. "The deformity (says he) may be restricted to one foot, or extended to both. In the first case, if the infant be examined shortly after birth, the affected foot will usually be found rather smaller than the other; but the two limbs are of the same length. When both feet are implicated, they are in general equally developed. In proportion as the time from the period of birth becomes longer, the atrophy becomes more and more evident, and the cause of it is very explicable. In fact, the child from instinct, as it were, bears upon the sound foot, on which all the weight of the body is thrown. The result is that its nutrition is more active; while the deformed foot, remaining comparatively inactive, must on the contrary dwindle away.

"But this atrophy is of two kinds, which have hitherto been confounded, though they should be discriminated: 1. Atrophy, according to the diameter of the limb; 2. Atrophy according to its length. The first kind chiefly affects the muscles, and hence the slenderness and weakness of the limb; the second extends both to the muscles and the bones; but its action on the skeleton is the most serious and important; for the atrophy of diameter may always be removed by exercise of the muscles, when the club-foot has been rectified; while nothing can correct the shortened state of the limb." Though the shortening of the muscles and tendons is generally less in degree than that of the bones, yet it seems to Dupuytren that it should be taken into consideration: "Thus (says he) the tendon of Achilles, at the age of 20, has lost so much of its length, that even after the natural direction of the foot has been restored, the patient in order to be able to bear on the ground, is obliged to wear a high-heeled shoe." Hence Dupuytren insists on the prudence of beginning the treatment of club-feet very early, in consequence of the greater facility of the cure. In a very young infant, the foot may be rectified by the mere hand, and without pain; but, at the age of 10 or 12 years, machinery becomes necessary, and, at a later period, it fails; for nothing will then restore the length of the limb, nor even its shape and complete functions. (*Dupuytren, Chir.*

t.iii. art.6.) Occasionally, a club-foot undergoes a spontaneous cure; of which an instance is recorded by Dr. Holtj. (*Repertoire d'Anat. et de Physiologie.*)

The cure of club-feet by division of the tendon Achillis, in cases otherwise irremediable, is one great improvement in modern surgery. Indeed, the division of other tendons for the relief of the permanent contraction and shortening of muscles, is now occasionally practised with decided success. (See TENDONS.)

DISLOCATION. An instance of a compound dislocation of the sternal end of the clavicle backwards, is related by Mr. Tyrrell. (See *St. Thomas's Hospital Reports*, vol.i. p. 261.) It was caused by the fall of a heavy mass of earth, which drove the sharp end of a pickaxe against the chest. When the finger was introduced into the wound, the great pectoral muscle was found torn from the clavicle, and the finger could be passed as far outwards as the coracoid process, and inwards to the trachea. The greater part of the interarticular cartilage remained in its place. There was emphysema below the clavicle and over the sternum, and difficulty of breathing. The shoulders were brought back with straps attached to a backboard, and the bone readily resumed its place. The elbow was brought forward and bound to the side. The case terminated well.

Sir Astley Cooper informs me, that the dislocation of the os humeri on the dorsum of the scapula is most readily reduced by bending the elbow, putting the hand behind the neck, and then inclining the lower end of the humerus backwards.

Mr. John Macdonnell has published the case of a simple and complete Dislocation of the Astragalus from the Os Calcis and Navicular Bone, upon the Dorsum of the latter, without Disturbance of the Relations between the Tibia, Fibula, and Astragalus, and without Fracture of any of these Bones. (See *Dublin Journ. of Med. Science*, vol. xiv. p. 235, &c.)

FINGERS, PERMANENT CONTRACTION OF. Under this head, I have introduced the opinion of Dupuytren on the cause of such contraction, viz., that the bands hindering the extension of the finger were produced by a permanent contraction of portions of the palmar fascia. The same view was adopted by the late Mr. Henry Cline, and, as would appear from an extract taken from his lectures, and published in one of the volumes of the *London Medical Gazette*, even prior to the period when Dupuytren taught the corresponding doctrine. The former had also anticipated the latter in the practice naturally dictated by such contemplation of the cause of the deformity. MM. Goyraud and Velpeau, however, object to the explanation of the subject given by Dupuytren; because the digital slips of the palmar fascia terminate in, and are fixed to the base and sides of the root of each finger, whilst the diseased band is situated in the middle of the finger, and is often prolonged to the third phalanx. They both concur, therefore, in ascribing this contraction to the transformation of a part of the subcutaneous cellular tissue in front of the phalanges, into a fibrous band. M. Sanson also believes, that this is the ordinary case, and that the contraction of the palmar fascia is an exception. The treatment, recommended by M. Goyraud, consists in making a longitudinal incision through the skin, over each band, when extended; to separate the lips of the wound; to detach the fibrous cords by dissection, and to cut across them when thus detached from their connections. (See *Gaz. Méd.* No. xxxi. and xxxii. Août, 1835.) Sir Astley Cooper passes a narrow knife under the cord, which is cut through without dividing the skin.

HERNIA. In the first volume of the *Trans. of the Medical and Surgical Association*, my friend, Mr. James, of Exeter, has inserted an interesting paper on the signs which distinguish the sac in hernia. Amongst others, not perhaps adverted to by writers, he mentions the *possibility of drawing* down more *of the intestine*. "If (says he) we have opened the sac, I believe I may affirm, that it will rarely happen that we cannot draw down some further portion, a very good practice too on many accounts; while, if we have not, this will be manifestly impossible.

"Another point, which has not been adverted to, is the very *size of the tumour*, which offers, as it appears to me, a highly important indication; for, if it be small intestine, it must, if exceeding the dimensions of an ordinary knuckle, present the appearance of a convolution, supposing the sac has been opened; or, if great intestine, it must exhibit its characteristic appearance of bands." (P. 151.)

Dr. O'Beirne is the author of some original observations on the primary causes of strangulation, and on what he considers to be an improved mode of performing the taxis in cases of intestinal hernia. The latter consists first in the introduction of a gum elastic tube into the sigmoid flexure of the colon, and retaining it there while the taxis is tried. Secondly, if this fails to diminish the size and dimensions of the hernial tumour, a syringe is attached to the tube, and emollient enemata thrown up, the same process being repeated until the bowels are sufficiently freed of their solid and fluid contents, and then the tube is again introduced, without the syringe being attached to it.

Dr. O'Beirne informs us, that he has employed this treatment, and seen it employed by others, during the last eight years, with the most gratifying results. Some of the cases alluded to, with an exposition of the principles on which they were treated, appeared in February 1833, in his work entitled *New Views of the Process of Defecation, &c.*, and others were afterwards recorded in the *Lond. Med. and Surgical Journ.* It is Dr. O'Beirne's doctrine, that the abdominal openings are perfectly inactive in the production of strangulation, and that the causes of this state exist in the protruded parts themselves. He argues, that when the protrusion takes place, a current of flatus is impelled into the protruded intestine, "which becomes so distended as to be driven (the sac alone being interposed) against the firm margins of the ring; and often with such force, as considerably to dilate the latter. The distention is of course resisted by the ring, and, according to the situation of the hernia, either by a strong or a weak fascia; but, below this point, the bowel being opposed by little more than common integuments, yields readily, and becomes rapidly enlarged to a size so disproportionate to that of the opening through which it descended, that it is no longer capable of repassing into the abdomen. There is at the same time another cause operating to prevent its return; for the great expulsor muscles, although they soon cease to act simultaneously, or, with the same force, still act so as to direct and maintain a constant current and pressure of flatus against the strangulated gut. There are reasons for believing, also, that the bowel is more or less enlarged above, as well as below the ring, so that the latter lies imbedded in a hollow formed by the sac and the intestine. In this way, pressure from within, and resistance from without, unite in causing the margins of the herniary opening, although totally inactive *per se*, to produce a much greater degree of constriction of the sac and the intestine, than they could possibly produce if they really possessed the activity attributed to them by many." Dr. O'Beirne differs from Mr. Geoghegan, in believing that, when a knuckle of intestine becomes strangulated, air may still pass into and out of the bowel so constricted, in consequence of the existence of a narrow channel of communication between the protruded bowel and that within the abdomen. That this is frequently the case, I think all practical surgeons will admit; but whether it is constantly the case, seems to me questionable. Be this as it may, Dr. O'Beirne contends that the cavity of the strangulated gut is not obliterated, but permits air to pass freely into and out of it; that all the portion of the small intestines within the abdomen and the whole of the cœcum and colon are dilated, and also afford free passage to the air; and that the rectum is contracted, and alone opposes the escape of this elastic substance. If previous to or during strangulation, the bowels should be loaded with solid and fluid feces, so as to prevent the passage of flatus, or the success of the first introduction of the tube, Dr. O'Beirne insists on the necessity of persevering with the aid of repeated enemata. The gum-elastic tube used by him is sixteen inches in length, and the syringe about seven inches long and one in diameter. The tube should be made stiff by immersion in cold water; made straight, and then a few inches of it are to be well oiled. It is to be introduced as the patient lies on his left side, and passed up inch by inch, and in the course of the rectum. If stopped, it may be slightly withdrawn, and afterwards passed gently upwards. But, if it cannot be got further up without much force, the syringe is to be attached to it, and fluid thrown up in a strong unbroken column, by an assistant against the point of resistance, while the surgeon urges the tube firmly upwards. Many other interesting observations on this practice have been inserted by Dr. O'Beirne, in the *Dublin Journ. of Med. Science*, vol. xiv. art. 7.

LITHOTOMY BY THE RECTUM. Performed by Mr. Dawson of the Liverpool Infirmary, on a little boy three years and a half old. The case, a sacculated calculus, bulging downwards, so as to be felt through the upper wall of the rectum. "A gum-lancet, having its anterior edge rounded and very keen, was laid flat on the finger, which, thus armed and oiled, was introduced through the anus, so as to reach a point a short distance beyond the recto-vesical pouch, when its edge was turned upwards, and a decided cut made by drawing the instrument from behind forwards in the median line, through the walls of the pouch, and up to the stone, on the hard surface of which the edge of the lancet was distinctly felt to grate." After a second cut, the calculus was displaced by the finger, and fell into the rectum, whence it was withdrawn with Pellier's double silver wire. For four days, urine was discharged from the rectum. On the tenth day, four ounces of urine passed in a full stream through the penis; and after this no urine was voided from the rectum. The child recovered favourably from the operation. (See *Trans. of Med. and Surgical Provincial Association*, vol. ii. p. 301. To the references at the end of the article LITHOTOMY, add *The Surgical Anatomy of the Perinæum by Thomas Morton, late House Surgeon in University College Hospital*, 8vo. Lond. 1838.)

LOWER JAW, EXCISION OF THE ENTIRE. (Case by John G. Perry. The disease necrosis, with several sinuses opening around the chin.) One of these having been laid open, the entire case of new bone was found to be dead, and in a great measure separated from the periosteum. The removal of the bone was, therefore, determined upon. An incision was made, along the basis of the jaw, from a short distance in front of the right masseter muscle to the corresponding point on the left side. The exposed bone was divided with a saw and cutting forceps, as near as possible to the angles of the wound, and the insulated portion removed. On the following day, the portion remaining on the right side, which had somewhat descended from the loss of the support of the central part, was removed without difficulty. At the end of three weeks, the remaining segment was taken away. After the cure, the patient was able to masticate solid food with the aid of the tongue, which rubs the morsel against the upper teeth; but, as there is no reproduction of bone, the lower teeth are almost useless, and they do not meet the upper. (See *Med. Chir. Trans.* vol. xxi. art. 17.)

MAMMÆ, DISEASES OF. (J. F. G. Nevermann, *De Mammarum Morbis Curandis Commentatio*. 12mo. Rostochii, 1838.)

NECROSIS. (George Gulliver, Exp. Enquiry into the Agency ascribed to the Absorbents in the Removal of the Sequestrum. See *Med. Chir. Trans.* vol. xxi. art. 1.)

OPHTHALMY. (Frederick Tyrrell, On a Successful Plan of arresting the Destruction of the Transparent Cornea from acute purulent Inflammation of the Conjunctiva.) This important Communication to the Royal Medical and Chirurgical Society of London was made by Mr. Tyrrell, subsequently to the period when the corrections of the article OPHTHALMY in this edition were finished. The principal blood-vessels of the cornea are derived from those of the conjunctiva, but it also receives a trifling supply on its inner surface from the vessels of the serous membrane which lines it. In acute purulent ophthalmy, the cornea is found by Mr. Tyrrell to mortify from a strangulation of its blood-vessels; and that this strangulation is produced by the chemosis or the elevation and tension of the conjunctiva covering the sclerotica. Having ascertained this, he did not fail to resort to means calculated to relieve without delay the tension of the conjunctiva in this state of chemosis, and, for this purpose, he tried the effect of a free division of it, made with due regard to the course of its principal blood-vessels. His plan consisted in raising and securing the upper eyelid, as in the operation for extraction of a cataract, and in then making free incisions into the sclerotic portion of the conjunctiva, and the subjacent loaded cellular membrane, without injury to any other texture. He deems it essential that the incisions extend close to the margin of the cornea, where the tension and pressure are the greatest, and that the direction of the wounds correspond to the intervals between the insertions of the recti muscles, so that the principal vessels of the scletoric conjunctiva may not be injured. Mr. Tyrrell recognises an analogy between this practice and that of making incisions for the relief of severe phlegmonous inflammation of the cellular tissue in other parts, where he has often seen gangrene arrested by making incisions through the skin and loaded cellular membrane, so as to relieve the tension and pressure which were impeding the circulation. Mr. Tyrrell's plan differs essentially from the old one, in which the incisions in the conjunctiva, for the relief of chemosis, were made in a direction corresponding to the margin of the cornea, and frequently extended completely around it; whereby vessels passing to the corneal portion of the conjunctiva must have been in a great measure, if not entirely, divided, and the supply of blood to that texture and the cornea more or less cut off. (See *Med. Chir. Trans.* vol. xxi. p. 414, &c.) In University College Hospital, the practice has been tried with success; and my colleague Mr. Quain, who has resorted to it in various instances, makes the most favourable report to me of its results. I feel disposed, therefore, to look upon it as an improvement which reflects considerable credit on the gentleman who is the author of it, and who has given a very scientific account of the principles on which its usefulness is founded.

VARICOCELE, AND VEINS, VARICOUS. To the information contained under these heads, I deem it right to add the following more particular statements on certain points: —

"Breschet's plan of pinching the veins, whether of the cord, or of the extremities, by forceps constructed for the purpose, has frequently answered, and has not often been followed by the severe and dangerous symptoms of phlebitis. The parts included in the forceps, not excepting even the vein itself, having sloughed, the ulcer heals. M. Sanson has constructed forceps for the same purpose, with blades so broad, that he keeps the sides of the veins in contact for the extent of nearly an inch. It is said to be not absolutely necessary that the vein should be included between the blades of the instrument, nor that adhesive inflammation should arise. It is sufficient that the vein be compressed, so as to stop the course of the blood, when a clot forms, which is subsequently absorbed, leading to obliteration of the cavity of the vessel." (*J. C. Crosse.*)

The passing of needles through the varicous vein, after the ingenious manner, first practised by Mr. Benjamin Phillips, for the obliteration of arteries, has been recently tried by Lallemant, Davat, and Velpeau. The last has also passed needles beneath the vein, and twisted a ligature circularly, or in the direction of the fig. 8. under the projecting ends of each needle, so as to compress the vein. Mr. Crosse has likewise tried this plan, and, although there was suppuration in the cellular substance, neither general fever, nor phlebitis arose, the patient being quickly cured of a troublesome ulcer, and the dilated vein restored, or obliterated. In University College Hospital, Mr. Liston follows the same practice, with the improvement of withdrawing the pins at the end of about forty-eight hours, whereby the sloughing and ulceration, produced by the pins being left to make their way out, as exemplified in the method adopted by the above-mentioned practitioners, are completely avoided. I consider this practice, as modified by Mr. Liston, to be, upon the whole, one of the best and safest plans for the obliteration of the channel of a vein.

A
DICTIONARY
OF
PRACTICAL SURGERY.

ABDOMEN. The BELLY. If the pelvis be reckoned as part of the abdomen, the latter may be said to extend from the diaphragm, which forms its upper boundary, down to the levatores ani, and, from the transversales muscles in front, to the spine, quadrati lumborum, and iliaci behind. Thus comprehensively viewed, the abdomen appears to contain and protect all the organs of digestion situated below the œsophagus, together with the urinary and internal organs of generation. However, when a surgeon speaks of the cavity of the abdomen, he generally means the space included within the great sac of the peritonæum, and, with this restriction, neither the kidneys nor the pelvic viscera are strictly within the abdomen. Anatomists divide the abdomen into different *regions*, the terms allotted to which are so frequent in the language of surgery, that some account of them in this Dictionary seems indispensable. In fact, without the knowledge of them, the pathologist can neither direct his inquiries with precision, nor communicate clearly the results of his investigations to others. (See *Dr. Quain's Anatomy.* p. 583. ed. 2.) The middle of the upper part of the abdomen from the ensiform cartilage down to a line drawn directly across, from the greatest convexity of the cartilages of the ribs on one side to the greatest convexity of the cartilages of the ribs on the other, is called the *epigastric region.* The spaces at the sides of the epigastric region are termed the *right* and *left hypochondria*, or *hypochondriac regions.* The *umbilical region* extends from the navel upwards to the line forming the lower boundary of the epigastric region, and downwards to a line drawn across from one anterior superior spinous process of the ilium to the other. The middle space, below the last line, down to the os pubis, is named the *hypogastric region.* The part of the abdomen, situated on the outside of the umbilical region to the right and left, or externally and posteriorly, with respect to the perpendicular lines, drawn on each side from the greatest convexity of the cartilage of the seventh true rib, is termed the *lumbar region* or *loin.* On each side of the hypogastric region is situated the *inguinal region*, or *groin*, with the *iliac fossa.* The *epigastric region* contains the middle part and the pyloric extremity of the stomach, the left lobe of the liver, the hepatic vessels, the lobulus spigelii, the pancreas, the cœliac axis, the semilunar ganglia, the aorta, the vena cava, and the crura of the diaphragm. The *left hypochondrium* contains the large end of the stomach, the spleen and narrow extremity of the pancreas, part of the colon, the renal capsule, and the upper portion of the kidney. The *right hypochondrium* contains the right lobe of the liver, the gall-bladder, part of the duodenum, some of the ascending colon, the renal capsule, and upper portion of the kidney. The *right lumbar region* contains the ascending colon, the lower half of the kidney, and part of the jejunum. The *left* contains the descending colon, the lower half of the kidney, and part of the jejunum. In the *hypogastric region* are the convolutions of the ilium, the bladder in children, and, in adults, both the bladder and the uterus, if distended. The *right iliac fossa* contains the cœcum, the ureter, and spermatic vessels, and the *left iliac fossa*, the sigmoid flexure of the colon, the ureter, and the spermatic vessels.

Although the upper boundaries of the abdomen are completely determined internally by the diaphragm, they remain quite undefined externally. The diaphragm being a moveable partition between the chest and the abdomen, alternately ascending and descending in respiration, must by such changes have the effect of occasioning a correspondent enlargement or diminution of one of these cavities at the expense of the other. Without attention to this fact, mistakes in diagnosis would be very frequent. A sword, entering at the same point, and in the same direction, may penetrate the thorax, or the abdomen, or both cavities, according to the position of the diaphragm at the moment of the injury.

The functions of the abdomen essentially require that its capacity should be continually varying; and had its cavity been circumscribed by an osseous case, like that of the cranium, or by a construction like that of the parietes of the chest, such an arrangement would have been totally incompatible with the offices of the abdominal viscera. So convinced is Cruveilhier of the facility with which the abdomen accommodates itself to the varying quantity of its contents, that he regards the doctrine as perfectly erroneous which refers the irreducible state of some herniæ to insufficiency of space within the peritonæum. "What," says he, "can we suppose a cavity incapable of receiving the bowels again, which will allow of eight or ten pounds of victuals and drink being suddenly introduced into it? and which, in tympanites, often becomes distended in a short time to twice or thrice its natural dimensions?" According to the judgment of this distinguished pathologist, the obstacle to reduction depends either upon adhesions, or a disproportion between the viscera and the passage through which they protrude, arising from hypertrophy of the omentum, or mesentery; or the altered relations of the peritonæum, drawn down by the displaced intestines. But though this explanation, so far as it goes, seems correct with reference to the causes of the impossibility of reduction, Cruveilhier's view should not lead us to forget, that certain cases every now and then present themselves where the viscera admit of reduction; but their return into the abdomen is followed by so much pain and indisposition, that the plan of keeping them there is unavoidably renounced.

In the treatment of several diseases and injuries of the abdomen, the surgeon cannot proceed one step with safety to his patient without the light of anatomy. Hernia, wounds, paracentesis, abscesses, are all so many cases where a surgeon, deficient in anatomical knowledge, would be likely to adopt very inefficient measures, or commit the most fatal mistakes. A surgeon, acquainted with the structure and extent of the sheath of the rectus, would have no difficulty in selecting the most advantageous place for the puncture, when matter collects within that investment of the muscle; and the practitioner, aware of the exact course of the epigastric artery, would never run any risk of wounding it either in tapping a dropsical patient, attempting to take up the external iliac artery, or dividing the stricture in inguinal and crural herniæ.

On being first consulted, surgeons, as well as physicians, too often neglect to institute a careful examination of the external parts of the body. Thus, either from carelessness or mistaken delicacy, they deprive themselves of the most simple, ready, and sure means of recognising the nature of the patient's complaint. Some diseases of the chest and abdomen are strikingly expressed on the surface; either in a permanent change of configuration, or in a temporary alteration of the natural movements, or both. (*Forbes, in Cyclop. of Pract. Med.*, art. *Abdomen, Exploration of.*) When obstinate constipation, great pain, nausea, and vomiting occur, let the surgeon always be sure, that these symptoms are not dependent upon hernia, the usual situations of which should be carefully explored. The methods of exploring the abdominal regions are three, viz. *inspection*, *manual examination*, or *palpitation*, as it is termed, and *percussion*. The assistance of the sight and touch alone is not what the practitioner should always be content with; for as there is more or less gas within the alimentary canal, and considerable arterial trunks pervade the abdomen, the sense of hearing may be exerted with as much success in the investigation of diseases of this part of the body, as in that of diseases of the chest. The parietes of the abdomen being capable of relaxation, the viscera may be felt directly through them; and, as Cruveilhier justly remarks, this is the only visceral cavity admitting of such exploration. Frequently, by means of palpation, tender, enlarged, or indurated points may be detected. In the first instance, however, a careful inspection of the surface of the abdomen should always be made. The practitioner should consider whether it is more bulky, or of less size, than natural. Swelling and tension, combined with pain, and a small frequent pulse, characterise acute peritonitis. In some cases, a circumscribed swelling points out the seat of the disease — the organ affected. How essential the knowledge of the various regions of the abdomen, and of the contents of each of them, will here be for the formation of a correct opinion, must be sufficiently manifest. In pregnancy, retention of urine, and encysted dropsy, the swelling has an oval, or protuberant form; in ascites, a broader, more expanded shape. In lead colic, the parietes of the abdomen seem retracted, or drawn inwards. When palpation is instituted, the abdominal muscles should be relaxed, and the patient's mind diverted from his case. The pressure should be made gently and gradually; for when it is too forcible and abrupt, the examiner's touch is confused, the patient is put to pain, and his muscles contract. According to Cruveilhier, it has even been known to occasion the death of children by lacerating the liver, or the spleen in a state of enlargement. In fact, this rude mode of palpation conveys to the surgeon no information which can be relied upon; for the uneasiness, or pain experienced, or the change of countenance, may be more owing to the roughness or force of the pressure, than to any disease in the region of the abdomen subjected to examination. In certain cases, like ascites, the exploration should be made, if possible, while the patient is standing up, because, in this position, the fluid gravitates and renders the parietes of the abdomen tense, so that the fluid is more plainly distinguished.

The presence of gas, or liquids, may be detected by percussion; that of liquids, or any foreign body, being made manifest by the dull dead sound, and the perception of fluctuation by the hand applied to the point opposite that which receives the percussion.

In diseases and injuries of the abdomen, the diagnosis is often attended with considerable obscurity. It might be supposed, that as the soft and yielding parietes of this cavity facilitate the manual examination of its viscera, the detection of any painful point about them, and the slightest change of their shape or volume, nothing would be more easy, than to trace disease in this part of the body through its different stages with great precision. But, as Cruveilhier remarks, this is far from being the fact. The vast number of organs contained in the abdomen, their great moveableness, the frequency of their displacement, the multitude of their diseases, the particular character of their vitality, which sometimes lets them attain a very serious state of disease, unattended by any urgent pain; and lastly, the difference of thickness of the parietes of the abdomen in different individuals, are undoubtedly the circumstances accounting for the frequent difficulty in the diagnosis. In surgical, as well as in medical cases, the same uncertainty is experienced. Thus punctured wounds of the abdomen are treated on general principles, because the practitioner seldom knows exactly what viscera are injured. The same observation is applicable to contusions of the abdomen. A man who had a hernia received the kick of a mule on the belly: severe colic and vomiting ensued; several surgeons believed that these symptoms arose from the hernia being strangulated, and recommended an operation. Cruveilhier objected to this proposal, which, however, was carried into execution: the patient died, and on opening the body, the small intestine was found torn completely across. In the North London Hospital a young man died this spring (1836), from the kick of a horse on the abdomen. During the four or five days which he lived after the accident, he frequently vomited, and the belly became considerably swollen. Effusion of blood, or of the intestinal contents, was foretold; but, until the *post mortem* examination took place, the exact nature of the injury remained doubtful. A laceration of the small intestine was then detected, attended with effusion of its contents. The man died of peritoneal inflammation.

Abdomen, Abscesses of the, may take place either in its cavity or its parietes, and may be acute or chronic. In fatal examples of peritonitis, a sero-purulent fluid is often found in the cavity of the abdomen. In some instances, the pus is circumscribed by adhesions, which are produced by coagulable lymph, and separate the abscess from the rest of the general cavity of the peritonæum. In other cases, purulent effusion in the abdomen is the consequence of the bursting of an abcess of some of the viscera, or of perforation of the small intestine by ulceration.

Chronic tumours of the mesentery, which, in scrofulous children, sometimes terminate in suppuration, diseases of the ovary, and other abdominal viscera, bringing on the formation of matter, may be followed by purulent extravasation. Dr. Seymour, in his work on *Diseases of the Ovaries,* relates the case of a young woman, who, after suffering hectic fever, the cause of which was not apparent, suddenly complained of acute pain in the abdomen, and in a few hours expired. On opening the body, a large quantity of pus was found effused in the peritoneal cavity from an abscess of the right ovary. Dr. Tweedie met with an ovarial abscess of the size of an orange, where the prominent symptoms were incontrollable vomiting and sympathetic fever. (*Cyclop. of Pract. Med.* art. *Abscess.*) I have seen several instances of ovarial cysts, which had become inflamed after tapping, and secreted a puriform fluid. A woman had an ovarial tumour, supposed to be an ovarial dropsy. After death, the cyst was found to contain twenty pints of well-formed pus. (*North Amer. Med. Journ.* 1826.)

Occasionally, however, salutary adhesions are produced between the viscera, and ulceration taking place, an outlet is obtained for the matter through the bladder, anus, or vagina. Thus in the case of a woman, who had had for a long while pains in the right lumbar region, supposed to proceed from suppuration of the kidney, because pus was voided with the urine, the right kidney was found after death in the natural state; but there was an abscess in the right ovary, which was adherent to the bladder, into which the pus had passed through an ulcerated communication. In another patient, who had voided pus by the anus, the right kidney was suppurated, and adherent to the colon, with which it communicated by a preternatural aperture. For many years, a woman had a hard tumour of considerable size in the abdomen: at length, the pain of it became intolerable; and just at the moment when her death was apprehended, an immense quantity of pus was suddenly discharged from the vagina. The pain abated; the swelling of the belly subsided; merely the remains of the induration were now perceptible; and the woman's health was perfectly re-established. (See *Lassus Pathologie Chir.* t. i. p. 138.)

In one case, an abscess communicated with the cœcum, to which and the parietes of the abdomen, the omentum had become firmly adherent. In this manner, a circumscribed cavity was formed, containing ill-conditioned pus, and three or four seeds of fruit, covered by earthy incrustation. (*Abercrombie on Dis. of the Stomach, &c.* p. 338.)

Abscesses of the liver are more common in hot than temperate climates. Frequently, the liver becomes adherent to the neighbouring parts, and then the matter may be discharged through the parietes of the abdomen, or into the colon, stomach, duodenum, or gall-bladder; from which latter the pus may descend by the biliary duct into the bowels, and be discharged *per anum,* an instance of which is recorded by Malpighi. Abscesses of the liver have been known to make their way through the diaphragm into the pleura, or into the air cells of the lungs, so that the pus was coughed up. Andral refers to one case, where an abscess of the liver communicated with the vena cava, and to another, where it burst into the pericardium. (*Anat. Pathol.* t. ii. p. 601.) At the request of the late Dr. Pinckard, I examined the body of a woman, in whose liver there were nearly three pints of pus; the case was remarkable on account of the gall-bladder having been annihilated, with the exception of a trivial portion of its fundus, which is now in my possession.

The kidney may be the seat of acute or chronic abscess. Sometimes the quantity of matter is small, and the texture of the organ but little changed. In other examples, the suppuration may be so copious that none of the original structure of the kidney is left, excepting its capsular investment, which is expanded into a cyst of considerable size, and filled with pus. I attended with Mr. Baker, of Staines, an old man, who had symptoms somewhat like those of stone, and one of whose kidneys was found after death converted into a cyst containing about a pint of purulent fluid. As Andral observes, renal abscesses are sometimes so large, that they may be felt through the parietes of the abdomen. (*Anat. Pathol.* t. ii. p. 633.)

Abscesses of the kidney may burst in the loins, or make their way into the peritoneum, the ureter, or the colon.

Abscesses between the peritoneum and abdominal muscles, or between the layers of these muscles, or under the integuments of the abdomen, are attended with considerable variety, according as they happen to be chronic, or acute; circumscribed, or diffused; small, or extensive. Those of the acute or phlegmonous kind, from stabs and contusions, are noticed in the article Wounds. As for chronic abscesses of the parietes of the abdomen, they should be opened in an early stage.

Hard indigestible substances, after being swallowed, are not unfrequently discharged from abscesses in some of the abdominal regions. (See *De La Grange, in Museum der Heilkunde,* b. iv. p. 154.: *a fish-bone, which had been swallowed,* *found in the abscess; Petit, Traité de Mal. Chir.* t. ii. p. 226.; *an awl, without a handle, extracted from an abscess of the abdomen; and many other analogous cases.*)

Encysted tumours are occasionally formed between the peritoneum and abdominal muscles, and attain an immense size, before they burst; a remarkable specimen of which is described by Gooch, (*Chir. Works*, vol. ii. p. 144, &c. 8vo. Lond. 1792.) In this case, the spontaneous opening in the navel was enlarged with caustic, and the cyst extracted; but, before a cure could be effected, it became necessary to make a depending opening, and introduce a seton.

Abdomen, Pulsations in the. From the article *Aneurism*, the reader will understand, that, though it be the common nature of this disease to be attended with throbbing, it is not every pulsating tumour that is an aneurism. The cases, usually called *abdominal* or *epigastric pulsations*, often furnish a proof of the correctness of the preceding remark. The authors, who have treated of the latter affection with the greatest discrimination, are Dr. Albers, of Bremen, and Mr. Allan Burns, of Glasgow, two gentlemen, whose high reputation and useful labours will long survive the termination of their meritorious lives. Some of the pulsations, here referred to, are the consequence of organic disease, and capable of demonstration by dissection; while the rest are not attended with any such appearance, and have therefore been regarded as nervous. The pulsation is not always produced by the impulse communicated to a solid tumour, or substance between the hand and the artery, but was conceived by Mr. Burns to be sometimes dependent on a nervous affection of the vessel itself. (*On Diseases of the Heart*, p. 263.) Hippocrates refers to three patients, affected with extraordinary pulsations in the abdomen. As one of these cases seemed to depend upon obstructed menses, it was probably not the result of any organic disease. (*Hippocratis Opera Omnia, ex edit. Fœsii. Francof.* 1621. lib. v. sect. 7. p. 1144.) In order to remove a difficulty in believing, how an artery, not affected with aneurismal enlargement, can communicate to the superincumbent parts such movements as are frequently remarked in cases of abdominal pulsations, a fact pointed out by Mr. Hunter should be remembered: in speaking of the actual dilatation of an artery, he says, that when the vessel is "covered by the integuments, the apparent effect is much greater than it really is in the artery itself; for, in laying such an artery bare, the nearer we come to it, the less visible is its pulsation; and when laid bare, its motion is hardly to be either felt or seen." (*On the Blood, &c.* p. 175. 4to. Lond. 1794.) And this observation will apply to all tumours and indurations situated over a large artery. In the epigastric region of a certain patient, Taberranus felt not only a pulsation, but a tumour as large as the fist, with all the other usual symptoms of an aneurism. On opening the body after death, he was therefore surprised to find, instead of this disease, a considerable scirrhous tumour in the middle of the mesentery, so closely connected to the large vessels, as to compress the aorta, by the pulsations of which it had been lifted up. (*Obs. Anat.* ed. 2. No. 9.)

Mr. Loudon, of Leamington, sent me the particulars of a case, where the pulsations of the aorta against a diseased liver, extending across the epigastrium, and occasioning a well-defined tumour at the pit of the stomach, had been mistaken by several practitioners for an aneurism of the aorta, which vessel was found after death perfectly sound.

I once visited with Mr. Miller, of Keppel Street, a thin old man for retention of urine, where the tumour, formed by distended bladder above the pubes, was attended with regular and strong pulsations, corresponding to those of the arteries. I am not aware, that any similar case is upon record.

With regard to pulsations in the left hypochondrium, Bonetus cites several cases, the tenour of which is to prove, that the cœliac artery and mesenteric vessels must have been affected, as they were found after death dilated and filled with black blood. (*Sepulchretum Anatomicum*, lib. i. sect. 9. Obs. 9, 25, 27, 30, 38, 42, 44, 45, and 46.) The conjecture of Bonetus and others, however, respecting the frequency of abdominal pulsations from dilatation of the cœliac and mesenteric arteries, by no means coincides with the results of modern observations. Mr. Wilson, whose dissections were numerous, met with only one instance of true aneurism, affecting any of the branches of the aorta, distributed to the abdominal viscera. This was an aneurism of the left branch of the hepatic artery. (*Lectures on the Blood, and on the Anatomy, Physiology, and Surgical Pathology of the Vascular System, &c.* p. 379. 8vo. Lond. 1819.) Bontius was present at the opening of an inhabitant of Batavia who had been afflicted three years with a disease, the exact nature of which could never be made out during life. When the hand was applied above or below the navel, a pulsation was felt like that of the heart, or an artery, and as forcible as the motion of a child in the womb. It was synchronous to the pulsation of the heart and arteries. Hence, Bontius concluded that the case was owing to some affection of the heart. The vena cava, instead of containing blood, was filled with a medullary substance, which pressing against the aorta, is supposed to have excited the extraordinary pulsations in that vessel. The heart was unusually dilated, and flabby. The two ventricles were very large, and filled with dark coloured blood. The liver was of nearly twice its natural size. The gall-bladder resembled that of a bullock, and was filled with viscid bile. (*Jacobi Bontii de Medicinâ Indorum*, libri iv. Lugd. 1718. Obs. 8. p. 101.)

A case is recorded by Burggraf, entitled, "Diuturna, magna, et valde molesta pulsatio in epigastrio." (*Vid. Acta Natur. Cur. Norimb.* 1740, vol. i. Obs. 131.) Burggraf suspected that the pulsation was caused by a dilatation of that considerable branch of the inferior mesenteric artery, which inosculates with the branch of the superior mesenteric. This idea, however, could not have been correct, as the patient was cured by taking, every morning and evening, half a drachm of a mass composed of equal parts of gum ammoniac, extr. centaur. minor, and Venice soap.

In an example recorded by Störk, the symptoms arose from disease of the pancreas, which weighed thirteen pounds, and contained a large cyst filled with lamellated blood. (*Annus Medicus*, Vindob. 1760, p. 245.)

A man, aged 60, complained of pain in the left side, midway between the umbilicus and crista of the ilium, followed by emaciation, weakness, distress of countenance, anorexia, and constipation. At length, a large pulsating tumour was discovered in the epigastric region. The case was now pronounced aneurism of the abdominal aorta. There was *no nausea nor vomiting*, except a few days before death, when a quantity of fetid blackish fluid was twice or thrice voided. *No fever.* The swelling caused a sense of constriction rather than pain, and the throbbing became more perceptible. The pulse was feeble, but *slow and regular*. After death, the stomach was found *adhering* to the liver, pancreas, and peritoneum; and a *cancerous tumor* occupied its internal surface from the duodenum to the insertion of the œsophagus, its coats being an inch thick. The surface of the pancreas was also diseased, and the pylorus, situated in the midst of the cancerous mass, was contracted by the thickening of the parietes of the stomach, and obstructed by numerous fungi. The liver was large, but apparently sound; the spleen small *The aorta, the cœliac trunk, and its branches were quite natural.* (See *Journ. de Méd. par Leroux*, Oct. 1815.)

Morgagni describes the case of a woman, 44 years of age, who, after a suppression of the menses for some months, was attacked with palpitations in the epigastrium. Morgagni, on applying his hand to the part, felt a large hard body moving forcibly. At first, it was regarded as an aneurism in the abdomen; but, as there were no similar throbbings in the chest, and there was nothing extraordinary in the pulse at the wrists, Morgagni concluded that the movements in question could not depend upon the heart. Neither did he take the disease for an aneurism, because the throbbings did not correspond to the pulse. Morgagni considered the case as an hysteric spasmodic complaint, ordered the patient to be bled, and the following day the pulsations ceased. (*Morgagni, de Sedibus et Causis Morborum*, t. ii. Epist. 39. 18.)

Senac has spoken of these abdominal pulsations as occurring in hypochondriacal and chlorotic patients; and, as they frequently subside, without leaving any vestige behind, he sets them down as nervous affections. (*Traité des Mal. du Cœur.*) De Haen had under his care a hypochondriacal patient, affected with pulsations in the abdomen; which, with other complaints, were dispelled by means of brisk opening medicines. (*Heilungs Methode, übersetzt von Plattner*. Leipz. 1782. b. ii. s. 29.)

Abdominal pulsations are described by Zuliani, as a symptom of hypochondriasis and hysteria. (*De Apoplexia*, Lips. 1790, p. 79.) They also happen in certain febrile diseases. (*Versuch über den Pemphygus und das Blasenfieber, von C. G. C. Braune*. Leipz. 1795. s. 23.; and *Dr. R. Jackson on the Fevers of Jamaica*, 8vo. Lond. 1791.)

Thilenius observed a flatulence of the stomach, which, in some patients, was attended with pulsations at the scrobiculus cordis. (*Med. Chir. Bemerk.* Frankf. 1789. s. 211—217. My friend, Mr. Hodgson, in speaking of pulsations in the epigastrium, which are not the consequence of organic disease, and occur in irritable hypochondriac subjects, states his opinion, that, in some instances, these pulsations are a consequence of distension of the stomach with air, which is thrown against the abdominal muscles by the pulsation of the great blood vessels; and in such cases, the throbbing is diminished by the eructations. (*On the Diseases of Arteries and Veins*, p. 96.)

Dr. Albers details some cases which fell under his own notice. A young woman, whose menses were upon her, and who had been for some days constipated, was seized with frequent fainting fits and febrile symptoms, occasionally voiding from the bowels a quantity of dark matter, each evacuation of which was followed by a swoon. One morning at five o'clock Dr. Albers was sent for, as it was feared the patient was about to die. She was extremely exhausted, and the fainting fits followed each other with hardly any intervals. She could just say, "I feel a throbbing in the belly;" and when Dr. Albers applied his hand to the part, he felt a violent pulsation, extending from the ensiform cartilage down to about the bifurcation of the aorta. The action of the heart was weaker than natural; the pulse at the wrist very small, but not quicker than it had been on the preceding day, and not synchronous to the throbbing in the abdomen. Dr. Albers confesses that, at first, he took the case for an aneurism. Dr. Meyerhoff was of the same opinion. Another physician, however, Dr. Weinholt, entertained doubts of the complaint being aneurismal, saying, that he recollected having read similar cases in Morgagni. These gentlemen decided to persevere in the employment of opening medicines and clysters, combining opium with the former. Under this plan, the pulsations in the abdomen and tightness of the chest diminished in a few days. The stools were at first of the colour of chocolate, but afterwards resumed their natural appearance. The throbbings, in a weakened form, however, were perceptible for six weeks longer. The patient at length got quite well, and was remaining so four years afterwards.

A man, about 40, severely afflicted with hypochondriasis, great oppression of the chest, constipation, and tension of the abdomen, tendency to fainting, &c., complained to Dr. Albers, that he felt as if his heart had fallen down into his belly, where he was annoyed with an incessant throbbing. Indeed, when Dr. Albers, examined the abdominal parietes, he could feel a very strong pulsation, and, what is curious, could trace it not only along the track of the aorta, but in the course of the left iliac artery. The pulse at the wrist, which was small, frequent, and hard, did not correspond with the abdominal pulsations. For several days, the evacuations from the bowels had been as black as pitch. After the employment of gentle purgatives all the complaints quickly abated, though the throbbings were feebly perceptible for nine months afterwards.

The next case, which Dr. Albers met with, is very interesting. A robust sailor, whose bowels were so constipated, that hardly the strongest purgative could affect them, was seized with constant pain in the left hypochondrium. With this complaint were soon joined great pain in the back, and a sensation as if something alive moved about in the belly from one side to the other, and thence extended up to the neck, followed by the vomiting of a greenish matter. At the same time, he felt in the left side a pulsation, which he took for that of the heart, and which continued throughout his illness. The pulse at the wrist was natural, and synchronous with that in the abdomen. In the beginning of the disorder the patient was obliged to sit with his body inclined forward, as no other posture could be endured. For the first week, opening medicines afforded so much relief, that he was sometimes quite free from pain for six or eight hours. After a time, a round swelling formed in the left hypochondrium, reached to the navel, and attained with incredible quickness the size of a child's head. Indeed, it could now be traced beyond the umbilicus to the right side. The motions were quite of a dark colour, or else red blood and a puriform matter were discharged. Sometimes the blood voided was of a bright red colour, sometimes it was dark, coagulated, and mixed with bile. The patient was at length worn out with febrile symptoms, and died. On opening the body, Dr. Albers found a swelling in the middle of the mesentery, the texture of which cannot be easily described, and the circumference of which was 16 French inches. The stomach was filled with coagulated blood. The spleen, pancreas, and liver were sound; but the gall-bladder was of prodigious size, and contained thick viscid bile. The cœliac axis, the coronary artery of the stomach, and the mesenteric artery were preternaturally dilated, and full of dark-coloured blood. Dr. Albers speaks of them, however, only as being in an enlarged, not an aneurismal state; and he thought it highly probable, that it was one of these vessels by which the pulsations had been occasioned.

Dr. Albers had also seen these abdominal pulsations in a paralytic female; and in a lunatic, who was afterwards seized with apoplexy. He likewise met with a married woman, the mother of several children, in whom these throbbings took place invariably at the commencement of pregnancy, and were a surer sign of this state than other common effects. After the third month, however, they used to cease altogether. (*J. F. Albers, über Pulsationen in Unterleibe*, 8vo. Bremen, 1803.)

In any persons not very fat, and lying upon their backs, the pulse of the aorta can easily be felt, if strong pressure be made a little to the left of the median line, about half way between the navel and scrobiculus cordis. In certain instances, the pulsation is painfully felt by the patient himself. In many cases of this kind, particularly in nervous individuals, the sense of pulsation is merely the effect of preternatural action of the heart; while, in other examples, it is the effect of the pressure of some hard substance upon the descending aorta, determining a disproportionate quantity of blood to the head, "and giving to the hand placed on the abdomen, and sometimes even to the eye, the appearance of a beating so near the surface, as to lead inexperienced observers to conclude that the aorta is morbidly dilated." According to Dr. Parry, the most common causes are collections of fæces in the colon, requiring repeated and active purgatives, which must bring away almost incredible discharges of stercoraceous matter before the aortal pulsation subsides. (See *Parry's Elements of Pathology, &c.*; and the *Medico-Chir. Journ. and Review*, vol. i. p. 157.)

I once attended with the late Mr. Ramsden, a boy in Christ's Hospital, who had a considerable abscess in the lumbar region, attended with distinct and forcible pulsations, corresponding to those of the aorta.

Three or four years ago, I was also consulted by Mr. Gilbertson, of Egham, in a case, where an enormous abscess in the epigastric region was accompanied by pulsations as strong and synchronous with those of the heart as the throbbings of an aortic aneurism.

According to Mr. Allan Burns, a beating is generally felt about the pit of the stomach, in the advanced stage of chronic inflammation of the heart: in this case, when the pericardium is closely adherent to the latter organ, it is corrugated at every contraction of the ventricles, and the diaphragm and liver are elevated. The ventricle, however, having completely emptied itself, is again distended, and, in proportion to the degree of dilatation, the liver and diaphragm descend, whereby an impulse is communicated in the epigastric region. (*On Diseases of the Heart*, p. 263.) This valuable writer cites the remark of Morgagni (Epist. 17. art. 28.), that sometimes in hypertrophy of the heart, this organ descends so far as to push the diaphragm into the hypochondrium, and pulsate in that situation, so that the disease is mistaken for an aneurism of the cœliac artery. In Mr. Burns' work a memorable case of this description is related. An erroneous judgment is the more likely to be formed in such examples, because the pulsations of the heart and tumour are not exactly simultaneous; for it is not the heart which is felt directly beating, but the liver, which, by the action of the heart, is thrown forwards. Hence the palpable interval between the stroke of the heart and the movement of the liver.

Preternatural pulsation about the epigastrium is stated by Mr. A. Burns to be sometimes occasioned by encysted tumours, attached either to the lower surface of the diaphragm, or formed between the layers of the pericardium towards the diaphragm, as happened in an instance recorded by Lancisi.

Another cause specified by Mr. A. Burns, is enlargement of the vena cava, or of the right auricle of the heart. Senac describes a case, in which the vena cava was as large as the arm, and there had been a violent pulsation in the epigastrium.

The next cause, enumerated by the same gentleman, is increased solidity of the lungs, more especially of their lower acute margins, where they overlap the pericardium. In this case, the pulsation is about the scrobiculus cordis.

Mr. A. Burns notices several other causes of epigastric or abdominal pulsations, already spoken of in the foregoing part of this article, indurations of the pancreas, scirrhus of the pylorus, tumours in the mesentery, or any solid increase of substance about the abdominal aorta, or its principal branches; and, lastly, a peculiar affection of the vascular system itself.

The following observations by Dr. Albers on the criteria between various abdominal pulsations and those of aneurism, appear interesting:—An internal aneurism originates gradually, and the pulsations increase in strength by degrees. Other abdominal pulsations, on the contrary, begin suddenly, and are most violent in the beginning, abating after they have lasted some time.

In an aneurism, the pulsation is synchronous with the stroke of the artery at the wrist; but this is not regularly the case with other pulsations.

Should the patient be affected with melancholia, hypochondriasis, hysteria, or other nervous complaints, void blood from the stomach, or a black matter from the bowels; should there be any hardness or swelling of the abdominal viscera discoverable by the touch, the probability is that the pulsations are not owing to an internal aneurism.

With the exception of cases, in which these pulsations are owing to mechanical impediments to the circulation, Dr. Albers believes that they are mostly a symptom of some nervous affection. He also thinks, that the surprise, excited by these throbbings, arises only from their strength and situation; other analogous, strong pulsations, as, for instance, those of the heart, or of the carotids, being common enough in hypochondriacal and hysterical persons. The same gentleman adverts to the increased action, which, in inflammation and fevers, is often more conspicuous in some parts of the sanguiferous system, than others.

See Ueber Pulsationem im Unterleibe. Bremen, 8vo. 1803. Obs. on some of the most frequent and important Diseases of the Heart; on Aneurism of the Thoracic Aorta; on Preternatural Pulsation in the Epigastric Region, &c. By *Allan Burns*, p. 262, &c. 8vo. Edinb. 1809.

ABSCESS (from the Latin *abscessus*). A collection of purulent fluid in the texture or substance of any part of the body capable of suppuration. If the pus is not within the tissue, but merely poured out into some regular and natural cavity of the body, where it forms an accumulation, the case is said to be one of *purulent effusion*, or of *suppuration* in the particular cavity affected, whether lined by a mucous, a synovial, or a serous membrane. When, however, the purulent matter is formed by a mucous membrane, where it invests any surface, passage, or duct, from which it is promptly voided externally, without producing any accumulation, the patient is said to have a purulent discharge. Familiar examples of this are seen in gonorrhœa and purulent ophthalmia.

When purulent matter is confined, and not infiltrated through the structure of an organ, it constitutes an *abscess*, the boundary of which is formed either by the tissue of the organ itself, or by what is termed an *accidental* tissue. In both cases, the formation of the boundary is accomplished by the effusion of coagulable lymph, which, in the former, produces the union and consolidation of the tissues of the organ in immediate contact with the pus, and thus prevents its diffusion; in the latter it forms a more or less perfect membrane over the whole of the surface from which the purulent secretion has taken place; and hence the pus being enclosed, as in a shut sac, the abscess is sometimes said to be *encysted*.

The cysts of abscesses have the power of absorption. In this manner, the occasional dispersion and subsidence of an abscess, without either bursting, or being opened, is accounted for. The cysts must evidently be also secreting surfaces; for, after the pus has been discharged, the cavity is soon filled with purulent fluid again.

Abscesses cannot be produced in certain textures. Thus, they cannot take place in the dense structure of fibrous or cartilaginous tissue, nor in that of serous membranes. When pus is discharged from these tissues, it is effused either upon their surfaces, or into the cavities which they invest; but abscess never forms in their proper substance. It is the prevailing doctrine, that abscess can take place only in parts into which cellular tissue enters as one of their constituents; and that this tissue is more frequently the seat of abscess than any other. John Hunter explained, that abscess is more common in superficial than deep-seated cellular tissue.

For an account of the tendency of abscesses to make their way to the surface of the body, or into a passage lined by mucous membrane; the theory of suppuration; qualities of pus; the general symptoms and treatment of abscesses; and other topics relating to this interesting subject; see SUPPURATION.

It is a contested point, whether an abscess can ever take place unpreceded by inflammation. Although John Hunter has a section in his work on the blood, entitled "Collections of Matter without Inflammation," yet his doctrines are decidedly in favour of suppuration being an effect of inflammation. At the present day, I believe the best pathologists would mostly concur on this point with Hunter. Thus Dupuytren affirms, that an abscess is never a primary disease, but invariably the effect or termination of a more or less intense and extensive inflammation of the living tissues. "Whenever," says he, "suppuration is observed in any part of our organization, whatever may be the qualities of the matter, we may be sure that some kind of irritation, acute or chronic, apparent or concealed, must have existed, or must yet exist, either in the situation occupied by the purulent collection, or in some remote part which communicates with this point, and is the source from which the matter is derived." Dupuytren maintains that this proposition is founded on the most accurate pathological investigations, and admits of no exception, whatever may have been asserted respecting collections of pus, supposed to be the result of substances absorbed and circulated for a time in the vascular system. Whether abscesses form slowly or quickly, whether they attain a considerable size or remain within narrow limits, or whether they contain pus of one quality or another, inflammation of more or less intensity, according to circumstances, seems to Dupuytren, and I may say, to the greater number of modern pathologists, to be always being concerned in their production. To this subject, however, I shall return in considering particularly the process of *suppuration*, under which head the formation, symptoms, and treatment of abscesses generally will be described. (See also ANTRUM, ANUS, BUBO, EMPYEMA, HYPOPIUM, LUMBAR ABSCESS, MAMMARY ABSCESS, PHLEBITIS, SCROFULA, and WHITLOW.)

ABSORPTION. That nature has fully provided for the due execution of this important function, is a truth of which no doubt is entertained: it must be immediately manifest to every person who reflects upon the mutation which is continually taking place in the particles of every texture of the animal body; upon the gradual and harmonious removal of the old matter in proportion as the new is deposited by the secerning arteries; or upon the impossibility of accounting for the changes produced by growth in the size and figure of different organs, and, indeed, of the whole body, without constantly bringing into the explanation this interesting process, of which numerous, and even the most essential, particulars, it is true, yet remain obscure. But besides these considerations in proof of absorption, many others must strike the contemplative physiologist. By the action of the secreting and exhalent arteries, the whole mass of blood would soon be so lessened, that life would unavoidably cease if the sanguiniferous system were not duly replenished in some way or another. The undiminished quantity of blood in the circulation, notwithstanding the constant deductions from it by secretion and exhalation; the regular fulness of the blood vessels, notwithstanding the incessant drain from them; and the constant supply of materials for the numerous secretions; all imply the existence of a certain function, one principal design of which is to counteract the effect, which, without it, would be rapidly and fatally produced upon the quantity of blood in the system. As M. Magendie observes, whenever any substance, in the form of a liquid, gas, or vapour, is put, for a certain time, in immediate contact with an external or internal surface of the body, it is *absorbed;* that is to say, it passes into the blood vessels, mixes with the blood, circulates with it, and thus occasions either salutary or noxious effects upon the system. This is particularly exemplified in the action of certain poisons: a drop of pure hydrocyanic acid, put on a dog's tongue, causes the animal's death in a few seconds, in consequence of being transmitted with the blood to the brain. Food, drink, medicines, and even air itself, only become useful to us, after having been absorbed. Many diseases, some of a very dangerous nature, are contracted by absorption. In fact, our existence is so inseparably connected with this function, that the suspension of it for an instant would produce almost immediate death. (See *Journ. de Physiol. Expérim.* t. i. p. 1.)

The uses of the absorbent system are far more numerous than would at first be supposed by a person only superficially acquainted with physiology and the phenomena of disease. If we wish to have a just comprehension of all the various purposes, which this system fulfils in the animal economy, we must take the same enlarged view of the subject as Mr. Hunter did. We must contemplate all the modifications of absorption, and its effects both in health and disease, in the nutrition and growth of the body, as well as in its emaciation, or atrophy, and the diminution, or even total removal, of parts of it which are diseased or useless.

First, According to Mr. Hunter's explanation, the absorbents take up extraneous matter, in which is included nourishment. (*On the Blood,* &c. p. 439.) By extraneous matter, we are here to understand matter not originally contained within any texture of the body, not constituting any part of its natural structure, but introduced from without. Thus, the absorption of mercury, arsenical paints, and lead, cantharides, and other substances, applied to the skin, furnish examples of the absorption of extraneous matter, which are also illustrated by the effects of the venereal, variolous, vaccine, and several other poisons. Sometimes the passage of the poison into the system, and its pernicious operation, happen so rapidly, that suspicions are entertained, that it must have a shorter track into the circulation, than through the lymphatic vessels, their glands and trunks. This has been suspected to be the case, when animals are killed with hydrocyanic acid, the nux vomica, the poison of certain snakes, the upas tiente, &c. How far this opinion is true will be hereafter considered. Such is the rapidity with which the poisons of upas tiente, nux vomica, and St. Ignatius's bean, are absorbed, and carried into the sanguiferous system, that in twenty seconds after being put into the cavity of the peritoneum, their action reaches the spinal marrow. (See *Magendie, Journ. de Physiologie Expérim.* t. i. p. 18.)

Secondly, As Mr. Hunter has noticed, the absorbents take up superfluous and extravasated matter, whether natural or diseased. Thus, the removal of the old particles of the body, after they have become unfit to continue longer in their respective situations and textures, — an action that is reciprocal with the deposition of new matter by the secerning arteries; and the incessant regulation of the quantity of serous fluid in the cavities of the abdomen, chest, pericardium, and tunica vaginalis, so that, though the arteries unremittingly secrete this fluid, the absorbents prevent its redundant accumulation, and combine with the blood vessels in maintaining a continual renovation of it; are examples of the absorption of natural, but superfluous matter. On the contrary, the dispersion of extravasated blood, of the fluid of ascites and anasarca, of coagulating lymph, or air, effused in the cellular tissue; and of an infinite number and variety of swellings and thickenings of parts; are instances of what Mr. Hunter has termed the absorption of superfluous diseased matter, or, as I should say, of superfluous matter from disease.

Thirdly, Mr. Hunter enumerates the absorption of fat. No doubt can exist respecting the continual change, which is taking place in the quantity of adipous matter in the body, according to the state of the health, the degree of exercise, fatigue, or labour, to which the body is exposed, the disturbed or undisturbed condition of the mind, and the effects of different kinds of regimen and diet on the whole system. Perhaps it may be inquired, why Mr. Hunter should distinguish this absorption from that of other superfluous matter in the body. The reason does not appear in his writings; unless we receive as such the observation, that he did not consider the fat and earth of bones, as true animal substances, as they have no action within themselves, and no principle of life. However, this would not be very consistent, because other superfluous matter, comprised in the second classification, especially the fluid secreted by serous membranes, and the fluid of anasarca, are likewise quite destitute of the living principle. At the same time, I admit, that the absorption of fat may be entitled to distinct consideration, on other grounds; for sometimes its absorption seems to be retarded in a much greater degree than that of other substances in the body; or, at all events, its absorption does not keep pace with that of its secretion, so that, although the muscles and other organs remain of their usual bulk, the fat may acquire the thickness of several inches. On the other hand, the absorbents sometimes act upon it with a quickness that does not always extend at the same time to other parts of the body. Thus, in fever, nearly all the fat may be absorbed in the course of a few days; yet the size of the muscles may have undergone but little reduction.

Fourthly, Mr. Hunter enumerates the species of absorption, by which a waste of parts is produced, and in consequence of which the muscles become smaller, the bones lighter, &c. These cases we find exemplified in the ordinary course of nature; for, in old age, such changes happen in the bones and muscles, and also in other organs, like the absorbent glands, which become so diminished, that some writers erroneously assert that they entirely disappear. Whenever the action of a muscle is long prevented by disease of a joint, a fractured bone, or other causes, it always dwindles away in a greater or less degree, and the limb, compared with the sound one, will be found to be considerably reduced. The absorption of fat, by which the bulk of parts is also lessened under various circumstances of disease, I believe, is not generally restricted to a particular limb, or part, like the absorption which affects the muscles in similar cases. Thus, when a patient becomes hectic from disease of the hip-joint, the muscles of the thigh and leg, on the same side as the disease, undergo a remarkable diminution of their bulk, while those of the sound limb are little, or not at all altered; but, the fat of the whole body is rapidly absorbed, and the greatest universal emaciation prevails.

Before the period of Mr. Hunter's inquiries, the knowledge of all the different purposes of absorption, by whatever organs it was supposed to be performed, whether by lymphatics or veins, was certainly very limited, in comparison with the more extensive information which now prevails, and which is, in a great measure, the fruit of his industrious researches. Speaking of the lymphatic vessels, which he considered, with the generality of physiologists, as the true instruments of absorption, he says: "From a further knowledge of these vessels, we shall find that they are of much more consequence in the body than has been imagined, and that they are often taking down what the arteries have built up; removing whole organs, becoming modellers of the form of the body in its growth; and removing many diseased and dead parts, which are beyond the power of cure."

As these vessels are productive of a great variety of changes in the animal economy, which are very dissimilar in their intention and effect, Mr. Hunter considered them in two general points of view: first, as they absorb matter, which is not any part of the body itself; secondly, as they absorb the body itself. The first of these uses, the absorption of matter, which is no part of the machine, he observes, is well known, and of two kinds; first, that of exterior matter, comprising every thing applied to the skin, and also the chyle; the other interior, comprehending that of many of the secretions, the fat, the earth of bone, &c. These kinds of absorption take place principally for the nourishment of the body; but they also answer other purposes, and are very extensive; for, besides their salutary effects, they are frequently the cause of disease in a thousand forms.

In the second of the above-mentioned views, Mr. Hunter considers the absorbents as removing parts of the body itself, and here he again views them in two lights. The first is, where only a wasting is produced in the whole body, or some particular part of it; to which mode of absorption he applies the epithet *interstitial*, because it consists in the removal of particles of the body out of the interstices of parts, which yet remain, and still form a perfect whole. This kind of absorption has always been admitted, or supposed, whether performed by the veins, or the lymphatics. It is often carried further than the mere wasting of the part; for, it may proceed till not a vestige of such part is left, as is sometimes exemplified in the total decay of a testicle. *Interstitial absorption*, therefore, may be understood in two senses.

The second view, taken by Mr. Hunter, embraces that kind of absorption by which whole parts of the body are removed, and which is sometimes a natural, sometimes a diseased, process. It is a view of which he particularly claims the discovery. In the natural process, he says, the absorbents are to be considered as the modellers of the original construction of the body. No alteration can take place in the original formation of many of the parts, either in the natural growth or the formation arising from disease, without the action of the absorbents, which always have a considerable share in the production of the changes. This he terms *modelling absorption*, the principle of which is as extensive as any in the animal economy. Bones and numerous other parts cannot be formed without it. A part, which is of use in one stage of life, but becomes quite useless in another, is thus removed, as is exemplified in the thymus gland, the ductus arteriosus, and the membrana pupillaris. In some cases the absorption of whole parts in consequence of disease leads to dissimilar effects; one is a sore, or ulcer; and Mr. Hunter therefore calls the process, by which it is produced, *ulcerative absorption*. In other cases, no ulcer is caused, although whole parts are removed. Both these forms of absorption, he thinks, might be named *progressive*.

The removal of a whole solid part of the body, or, as Mr. Hunter expresses it, "that power which the animal economy has of taking a part of itself into the circulation, by means of the absorbent vessels, whenever it is necessary," is unquestionably one of the most curious facts which can present themselves to the notice of the physiological inquirer. In Mr. Hunter's time, the doctrine was a new one; but he informs us that he had long been able to demonstrate its truth, and that he received the first hints of it from the waste of the sockets of the teeth, and of their fangs at the period of their being shed.

"It may be difficult at first to conceive how a part of the body can be removed by itself; but it is just as difficult to conceive, how the body can form itself;" yet they are both equally facts. Without dwelling on the exact mode in which such changes happen, he gives it as his belief, that "whenever any solid part of our bodies undergoes a diminution, or is broken in upon, in consequence of any disease, it is the absorbing system which does it.

"When it becomes necessary, that some whole living part should be removed, it is evident that nature, in order to effect this, must not only confer a new activity on the absorbents, but must throw the part to be absorbed into such a state as to yield to this operation." (See *Hunter on the Blood*, &c. p. 439—442.) For an account of *ulcerative absorption*, vide Ulceration.

With regard to the difficulty in conceiving, how tubes, so small as the lymphatics, can take up solid substances, Bichat argues that the distinction between the solids and the fluids can only be said to prevail when they form a mass; but, that when reference is made to their separate elements, they do not differ from one another. This, he says, is so perfectly true, that the very same elementary constituent will alternately enter into the composition of a solid and a fluid, just as the elements of water are the same, whether it be in the liquid or frozen state. Now, as the absorption of solid substances takes place by the removal of these elementary principles, or atoms, no greater difficulty can present itself in understanding how this may be effected, than in conceiving how fluids may be absorbed. (See *Anat. Gén.* t. ii. p. 92.)

The source of the lymph is less certain than that of the chyle; for, even at the present day, M. Magendie, influenced by the possibility of injecting the lymphatics from the arteries, and by the uniform nature of the lymph, and its analogy to the blood, professes a belief, which was common many years ago, that it is not formed by the decomposition of the old particles of the body, nor by fluids absorbed from various surfaces; but that it is composed of the thinner parts of the blood, which, instead of returning by the veins to the heart, pass into the lymphatics, and are conveyed to that organ through the thoracic duct. The lacteals certainly have little disposition to take up any thing but chyle; but, as Dr. Bostock has explained, " the lymphatics are capable of absorbing a great variety of substances, differing from each other most widely in their nature, so that it would almost appear as if, by a certain mode of application, any substance might be forced into them. Nor (says Dr. Bostock) is this conclusion affected by the hypothesis of M. Magendie; for, although we might agree with him in supposing that, in the ordinary operations of the system, the veins are the principal, or even the sole instruments in removing the materials of which the body is composed, yet we have unequivocal evidence, that, when certain poisonous or medicinal agents are applied to their extremities, they may be received, or forced into them, and conveyed into the circulation. The case of metallic or other medicinal substances that are taken up by the lymphatics, may appear to be less difficult to explain, because the absorption is generally produced by friction or some mechanical process, which may be supposed to force the substance into the mouths of the vessels, or to produce an erosion of the epidermis, which may enable the substances to come into more immediate contact with the mouths of the vessels. We may also imagine that, when the component parts of the body are brought into close approximation with their capillary extremities, they are then taken up in the same way that the chyle is absorbed from the intestines." (*Elem. Syst. of Physiol.* vol. ii. p. 583.) Many physiologists have little difficulty in conceiving how fluids can be taken up by the lymphatics, but rather stagger at the notion of this being also the case with the hardest solids. Others, however, accommodate their creed to both hypotheses, reconciling themselves to them by the argument that, if the minute capillary arteries can secrete this dense, hard matter, the small lymphatics can remove it. One example is not more difficult to comprehend than the other. Yet, such reasoning throws little light on the questions, how are the solids prepared for absorption, and in what manner are they taken up? These, in fact, remain completely unanswered.

" What (inquires a judicious physiologist) are we to conceive of the intimate nature of this operation? If solution of the substance be necessary, we are at a loss to find a proper solvent; many of the substances are insoluble in water, or in the serous fluid which is found in the vessels; while, on the other hand, it is perhaps not easy to conceive how the substances can be absorbed without being previously dissolved, and still more so, how the solids can have their texture broken down, and enter the vessels, particle by particle, as it were, and be suspended in the lymph in a state of extreme comminution?" These difficulties some physiologists, including Bichat, endeavour to diminish by arguing that the lymphatics must be supposed to act only upon the elements of every texture, and, that on this principle, the absorption of solids is as readily intelligible as that of fluids, the same elements frequently contributing to the composition of both.

While parts retain the vital principle, they resist the action of the absorbents. Dead matter is more easily acted upon by the absorbents than living; and, in fact, " no part can be absorbed until its texture is destroyed, and, consequently, until it is deprived of life. No substance can possibly enter the absorbents, while it retains its aggregation, so that it necessarily follows, that the preliminary step to the absorption of the body is its decomposition." (*Bostock, Elem. Syst. of Physiol.* vol. ii. p. 585.) This able physiologist afterwards explains, that by the death of a part, preceding its absorption, is here signified, only " that it is no longer under the influence of arterial action. It therefore ceases to receive the supply of matter which is essential to the support of all living parts, and the process of decomposition necessarily commences." A better account of the subject appears to be that, which, dismissing all metaphysical and chemical reflections upon the supposed death and decomposition of parts, previously to their absorption, represents the absorbents as acting directly upon the individual atoms, particles, or elements of the various textures. We know nothing about the vitality of these atoms, or elements, in their separate capacity; supposing them to possess it, we know nothing of the moment when they part with it previously to their entrance into the absorbent system, just as we are completely ignorant both of the manner in which such elementary materials acquire the vital principle, and of the exact moment when they become thus endued.

In the foregoing observations, the lymphatics have been presumed to be the true instruments of absorption; by which is meant, not merely that they contain lymph, and transmit it into the venous system, a fact of which no doubt is entertained by any class of physiologists; but, that such lymph is really produced by the operation of these vessels upon the various kinds of matter presumed to be taken up by them, and to consist of all the old particles of every texture of the body, the fat, the earth of the bones, and the superfluous quantity of many different secretions, naturally undergoing continual renovation, besides the chyle which is taken up by the lacteals, and conveyed to the thoracic duct, or common trunk of both descriptions of vessels. To this view of the subject, some physiologists of eminent talents do not accede, and even if it should hereafter be decidedly proved, that the lymphatics possess the power of absorption, the tendency of numerous experiments performed by MM. Magendie, Fodera, and others, is to show that, at all events, they are not the only absorbents, and that the veins are actively concerned in the function. It appears also from various observations and experiments, that substances may enter directly into the blood vessels, and thus get at once into the circulation, or else be conveyed from the surface on which they are placed, through it and the contiguous tissues, into the blood by what M. Magendie terms *imbibition*. In both these modes, it is inferred that absorption does not necessarily require any action or assistance of the lymphatic vessels themselves, the commencement of which, upon every surface and in every texture, by innumerable orifices or mouths, is not regarded by some distinguished physiologists of the present day, as a doctrine by any means well established. Of course, what Hunter would explain on this principle, they would refer to imbibition, in which the absorbed matter passes through the textures of parts into the circulation, or else gets more directly into the blood vessels.

ACETATE OF LEAD. See Lead.

ACETATE OF MORPHIA. See Morphia.

ACETIC ACID. *Distilled Vinegar;* contains five per cent. of acetic acid, and, when mixed with farinaceous substances, is frequently applied to sprained joints, and, in conjunction with alcohol and water, makes an eligible lotion for many cases, in which it is desirable to keep up an evaporation from the surface of inflamed parts. Vinegar was once considered useful in quickening exfoliations, which effect was ascribed to its property of dissolving phosphate of lime. Its good effects on burns and scalds were taken particular notice of by Mr. Cleghorn, a brewer in Edinburgh, whose observations were deemed by Mr. Hunter worthy of publication. (See *Med. Facts and Obs.* vol. ii.)

Diluted vinegar is alleged to be the best lotion for freeing the eye from any small particles of lime which happen to have fallen into, and become adherent to it, or the inside of the eyelids. (See *A. T. Thomson's Dispensatory*, p. 8. ed. 2.)

Distilled vinegar is sometimes employed as a styptic for stopping hemorrhage from the nose. With this view, it may be used either as an injection, or a lotion, in which lint is dipped, and introduced up the nostril. It is often used to lessen the disagreeable smell of sick rooms. Acetic acid is one of the most certain applications for the destruction of warts and corns, care being taken not to injure the surrounding skin with it. (*Brande's Manual of Pharmacy*, p. 9. 8vo. Lond. 1825.)

The pyroligneous acid, which is merely strong acetic acid impregnated with empyreumatic oil and bitumen, is commended by Mr. Buchanan, of Hull, as an ingredient in applications to the ear for the relief of certain cases of deafness. (See *Illustrations of Acoustic Surgery*, 8vo. Lond. 1825.)

ACHILLES, *Tendon of*. See Tendons.

ACTUAL CAUTERY. A heated iron, formerly much used in surgery for the extirpation and cure of diseases. Its shape was adapted to different cases, and the instrument was often applied through a canula, in order that no injury might be done to the surrounding parts. *Actual* cauteries were so called in opposition to other applications, which, though they were not really hot, produced the same effect as fire, and consequently were named *virtual* or *potential cauteries.* The actual cautery is still in common use upon the Continent; and by foreign surgeons we are not unfrequently criticised for our general aversion to what they distinguish by the appellation of an *heroic* remedy. Pouteau, Percy, Dupuytren, Larrey, Roux, Delpech, and Maunoir, are all advocates for the practice; and the latter gentleman, when he was in England, took the opportunity of reminding British surgeons of their error, in abandoning, as most of them do, the employment of heated irons. (See *Obs. on the Use of the Actual Cautery, Med. Chir. Trans.* vol. xiii. p. 364, &c.) The few cases, in which the actual cautery is occasionally used by British surgeons, are noticed in the articles Hemorrhage, Joints, Urinary Fistulæ.

ACUPUNCTURE (from *acus*, a needle, and *pungo*, to prick). The operation of making small punctures in certain parts of the body with a needle, for the purpose of relieving diseases, as is practised in Siam, Japan, and other oriental countries, for the cure of headachs, lethargies, convulsions, colics, &c. (See *Phil. Trans.* No. 148.; and *Wilh. Ten. Rhyne, de Arthritide, Mantissa Schematica, &c.* 8vo. Lond. 1683.) Dr. Elliotson has tried acupuncture extensively, and his experience coincides with that of Mr. Churchill, confirming the fact that, as a remedy for chronic rheumatism, it answers best where the disorder is seated in fleshy parts. He also finds, that one needle, allowed to remain an hour or two in the part, is more efficient than several, used but for a few minutes. (See *Med. Chir. Trans.* vol. xiii. p. 467.) Neuralgia is a disease in which the practice may deserve trial. Local paralysis is another. In a modern French work, it has been highly commended; but the author sets so rash an example, and is so wild in his expectations of what may be done by the thrust of a needle, that the tenor of his observations will not meet with many approvers. For instance, in one case, he ventured to pierce the epigastric region so deeply, that *the coats of the stomach were supposed to have been perforated: this was done for the cure of an obstinate cough, and is alleged to have effected a cure!* But, if this be not enough to excite wonder, I am sure the author's suggestion *to run a long needle into the right ventricle of the heart,* in cases of asphyxia, must create that sensation.

See *Berlioz*, Mém. sur les Maladies Chroniques, et sur l'Acupuncture, p. 305—309. 8vo. Paris, 1816. *Churchill* on Acupuncture, 1824; *Dantu*, Traité de l'Acupuncture, 1826.

ADHESIVE INFLAMMATION. That kind of inflammation by means of which parts of the body adhere or grow together. Also, the process by which recent incised wounds are united, without any suppuration, and frequently synonymous with union by the first intention. (See Inflammation *and* Union by the First Intention.)

AGARIC. A species of fungus, growing on the oak, and formerly celebrated for its efficacy in stopping bleeding. (See Hemorrhage.)

ALBUGO (from *albus*, white). A white opacity of the cornea, not of a superficial kind, but affecting the very substance of this membrane. See Leucoma.

ALUM, *Sulphate of alumina.* Ten grains of alum, made into a bolus with conserve of roses, may be given thrice a day in internal hemorrhages, gleet, leucorrhæa, and other cases demanding astringent remedies. In a relaxed state of the urinary passages, or want of power of the sphincter vesicæ, small doses of alum are said to have been of service. Alum is employed as an ingredient in many astringent lotions, gargles, injections, and collyria. Dr. Groshuis, a Dutch physician, first recommended its use in colica pictonum, and Dr. Perceval subsequently joined in the advice. The principle, on which it acts, is that of decomposing the common preparations of lead, and converting them into sulphates, which are comparatively innoxious. Burnt alum is a principal ingredient in many styptic powders.

ALVINE CONCRETIONS. See Intestinal Concretions.

AMAUROSIS (from ἀμαυρόω, to darken). *Gutta serena. Suffusio nigra.* Germ. *Schwarzer Staar.* That diminution or total loss of sight, which immediately depends upon a morbid state of the retina and optic nerve, whether this morbid state exist as the only defect, or be complicated with other mischief; whether it be a primary affection, or a secondary one, induced by previous disease of other parts of the eye. (*Beer.*) All those imperfections of vision which depend upon a morbid condition, *whether affecting structure or function*, of the sentient apparatus proper to the organ. (*Travers' Synopsis of the Dis. of the Eye*, p. 293.) *All affections of the nerves of vision, which produce either complete or partial loss of sight*, whether this arise from obvious or inferred organic disease, or from a diminution or loss of sensibility in the eye, which cannot be traced to change of structure, or any other evident cause. (*Journ. of Foreign Med. and Surgery* vol. iv. p. 166.) Obscurity of vision, depending on a more or less insensible state of one or several of the nervous parts, which assist in forming the optic apparatus: it is a disease, therefore, arising from causes entirely different from those which prevent the rays of light from entering or passing through the eye. (*Wm. Mackenzie on Dis. of the Eye*, p. 897. ed. 2.) Any great imperfection or loss of vision existing independently of any change in the natural transparency of the parts anterior to the retina, or of any manifest varicose enlargement of the vessels of the choroid, or of any material alteration in the configuration of the eye-ball. (*R. Middlemore on Dis. of the Eye*, vol. ii. p. 242.) This definition does not embrace so many cases as several of the others.

The definition of amaurosis, given by Mr. Lawrence, is correct and comprehensive; namely, the imperfection or loss of sight, which results from affection of the nervous apparatus belonging to the eye, whether that affection be seated in the retina, the optic nerve, or the sensorium; whether it be idiopathic or primary, sympathetic or secondary; whether it consist in vascular congestion, or organic change, or simply in functional disturbance. (*On Dis. of the Eye*, p. 487.) By the expression *gutta serena*, is usually signified the complete or fully developed form of amaurosis, that in which the patient has little or no power of distinguishing light from darkness.

Amaurosis then does not uniformly take place as a single independent disorder; but not unfrequently presents itself as a symptomatic effect of some other disease of the eye: a fact, exemplified in hydrophthalmia, cirsophthalmia, glaucoma, &c. And, as Mr. Wardrop observes, amaurosis, in its usual acceptation, signifies a symptom of disease, as well as a distinct affection. (*Essays on the Morbid Anatomy of the Human Eye*, vol. ii. p. 165. 8vo. Lond. 1818.) With respect to the mere name of the kind of disease here implied by amaurosis, its correctness will remain the same, whether the iris be moveable or immoveable; whether the pupil be preternaturally enlarged, or contracted; and whether it be perfectly clear and transparent, or more or less turbid; for the name only refers to the morbid state of the retina and optic nerve, and not to the condition of the sight in general. When the long established name of *amaurosis* is received with this precise meaning, there will not be the slightest danger of confounding the disease with other affections of the eye. However, when it is wished to make out the different forms and kinds of amaurosis, the appearances of the iris and pupil are considerations of great importance. (See *Beer's Lehre von den Augenkrankheiten*, b. ii. p. 420, &c. Wien, 1817.)

Genuine uncomplicated amaurosis, consisting of a mere diminution or loss of sight, without the appearance of any other defect, is one of the most uncommon forms of the complaint. In it, merely the vital properties of the optic nerve and retina are affected, and, after death, nothing preternatural can be traced in these parts. In short, the case is one in which the functions of the retina are imperfect or destroyed, the eye appearing in other respects sound.

This simple unmixed form of amaurosis is subdivided by Beer into that amaurotic weakness of sight, or blindness, which depends upon the sensibility of the optic nerve and retina being too highly raised, and into another case, the proximate cause of which is peculiarly and entirely referrible to depression of such sensibility. The first example is much less common than the second. Mr. Lawrence conceives, however, that they who divide amaurosis into two kinds, *that with increased*, and *that with diminished sensibility of the retina*, enumerate as symptoms of the former various kinds of impaired vision, some of which rather denote the period of excitement in disease of the retina, than the more advanced stage, ordinarily designated as amaurosis. (*On Dis. of the Eye*, p. 508.) With reference to some amaurotic patients, who are annoyed by the bright light of day, Mr. Middlemore also observes, that it would seem as if the sensibility of the retina were increased, although the power of vision is greatly diminished; but, he adds, this is usually nothing more than an early symptom of only some few varieties of amaurosis; it does not continue so as to constitute one of its latter symptoms. (*On Dis. of the Eye*, vol. ii. p. 257.)

Amaurosis does not constantly attack both eyes at the same time; frequently one is attacked some time after the other, and it is not unusual even for one eye to remain sound during life, while the other is completely blind. This depends, in part, upon the disposition to the disease in one eye being quite local, and in part upon the causes giving rise to the complaint extending their operation only to the eye affected. Where, also, the origin of amaurosis seems to depend altogether upon constitutiona causes, one eye is not unfrequently attacked much sooner than the other; though, in these examples, it is more rare to find the eye, which does not suffer at first, continue perfectly unaffected. (*Beer*, b. ii. p. 422.) As a general observation, Mr. Wardrop thinks it may be remarked, that when only one eye is at first amaurotic, from a sympathetic affection, there is little danger of the other eye becoming blind; but that when amaurosis is produced by any organic change in one eye, the other is very liable to be sympathetically affected. (*Essays on the Morbid Anatomy of the Human Eye*, vol. ii. p. 190.) Mr. Middlemore represents amaurosis as commonly attacking one eye first, and not commencing in the other until vision in the one first attacked is either much impaired or totally destroyed. "It is (says he) by no means an usual occurrence for amaurosis to take place in each eye at the same time, and to advance in both with an equal progress." Still, he admits, that this matter will be mainly determined by the nature of the cause producing the amaurotic affection. (*On Dis. of the Eye*, vol. ii. p. 251.) Indeed, since amaurosis may arise from affections of the sensorium, optic nerve, or retina, we can understand how it happens that it sometimes appears in both eyes at once; that it may be confined to one, or that, having taken place in one, it may in the other also, after a longer or shorter interval. (*Lawrence, Op.* cit. p. 489.)

Amaurosis may not completely hinder vision, a diminished power of seeing often remaining during life. Hence the division of cases into *perfect* and *imperfect;* which latter, however, sometimes attain a degree in which the patient is only just able to distinguish light, the direction of its rays, and its degree.

Imperfect amaurosis, besides being characterised by a considerable weakness of sight, approaching to actual blindness (*Amblyopia Amaurotica*), is mostly complicated with a greater or lesser number of other morbid effects. Amongst the most important of these, is a defective interrupted vision (*visus interruptus*). For instance, when the patient is reading, single syllables, words, or lines cannot be seen, unless the eye be first directed to them by a movement of the whole head, and greater or lesser portions of other objects are, in the same manner, indistinguishable. Sometimes, amaurotic patients can see only the upper or lower, or the left or the right half of objects. (*Visus dimidiatus; Amaurosis dimiadata; Hemiopia; Hemiopsia.*)

Sometimes, when the patient shuts one eye, he can only distinguish the halves of objects; but, if he open both eyes, he sees every thing in its natural form. In this case, one eye is sound, and only some fibres of the nerve of sight are injured in the other. (See *Schmucker's Vermischte Chir. Schrift.* b. ii. p. 12.)

In some not very uncommon cases of imperfect amaurosis, the patient cannot see an object, unless it be held in a particular direction before the eye; but, when the eye or head is moved in the least, he loses all view of the thing, and cannot easily get sight of it again. (*Beer, Lehre von den Augenkrankheiten*, b. ii. p. 424.) Patients who may be said to be entirely blind, sometimes have a small part of the retina which is still susceptible of the impression of light, and is usually situated towards one side of the eye. This obliquity of sight was long ago pointed out by the late Mr. Hey, as common in the present disease. (See *Med. Obs. and Inquiries*, vol. v.) Richter mentions, that, in one man, who was, in other respects, entirely bereft of vision, this sensible point of the retina was situated obliquely over the nose, and so small, that it was always a considerable time before its situation could be discovered: he adds, that it was so sensible, as not only to discern the light, but even the spire of a distant steeple. The centre of the eye seems to be first and most seriously affected. Hence, the generality of patients, in the early stage of imperfect amaurosis, see objects, which are laterally situated, better than such as are immediately before them. (*Anfangsgr. der Wundarzn.* b. iii. kap. 14.)

One of the most common symptoms of a beginning amaurosis, is an appearance in the patient's fancy, as if gnats, or flies were flying about before his eyes. (*Visus Muscarum, Myodesopsia.*) Sometimes, transparent, dark-streaked, circular, or serpentine diminutive bodies appear as if flying in greater or lesser numbers before the eyes, often suddenly ascending, and as quickly falling down again, and chiefly annoying the patient and confusing his sight when he looks at strongly illuminated or white objects. The substances, thus appearing to fly about before the patient's eyes, are termed *Muscæ volitantes; Mouches volantes.* (*Beer, Lehre, &c.* b. ii. p. 424.) If what obstructs the sight be a single black speck, it receives the name of *scotoma.*

This illusive perception, of various substances being in rapid motion before the eye, gradually increases; the substances themselves become less and less transparent, and, at length, are so connected together, that they form a kind of network, or gauze, by which all objects are more or less obscured. This is another symptom of amaurosis, technically called *visus reticulatus.* The network commonly has the peculiarity of being black in very light situations, or when white substances are before the eye; while, in dark places, it is quite shining, and, as it were, of a bluish white hue, like silver, though sometimes of a red-yellow, golden colour.

A not uncommon symptom of imperfect amaurosis is the patient's seeing every object indistinctly in a rainbow-like, sometimes tremulous, and generally very dazzling light; while, in the dark especially, blue or yellow flashes, or fiery balls seem suddenly to pass before his eyes when the eyelids are shut, and excite considerable alarm. (*Visus lucidus; Marmoryge Hippocratis; Photopsia.*)

In imperfect amaurosis, the sensibility of the retina may be so augmented, that the patient shuns all light places, particularly those in which the light is strongly reflected into the eye, and, in order yet to discern in some measure large objects, he feels himself obliged always to seek shady, darkish situations, or to screen his eyes, out of doors, with a green shade, or green glasses. This state is termed by Beer, *Lichtscheue.* (*Photophobia.*) Under these circumstances, it sometimes happens, that the patient, for a very short time, for example, a few moments, or (what is uncommon) for a more considerable period, is able of himself to discern the smallest objects in a weak light, more plainly and accurately than the best eye can hardly do in a good light. Yet, excepting at such period, the patient, with the above degree of light, is not capable of seeing even larger objects. This infirmity of sight receives the name of *oxyopia.*

Sometimes, in the early stage of amaurosis, all objects seem covered with a dense mist; while, in other instances, this mist first presents itself as a simple, continually increasing scotoma, and rarely in the form of a network, or gauze; but to the patient, when his blindness commences with the *visus nebulosus*, the mist usually appears for a day or two of a light grey colour, and then for another day or two very black, every thing appearing as if looked at through a dense sooty smoke. (*Beer, Lehre von den Augenkrankheiten*, b. ii. p. 422-26.)

To an eye affected with imperfect amaurosis, all objects frequently appear indistinct, but double. (*Visus duplicatus; Diplopia.*) When the disease comes on gradually, the patient sometimes sees double, with both eyes. Schmucker once cured a major of hussars, who saw the three lines of his squadron double; and he attended another gentleman similarly afflicted. Such cases, he conceives, are brought on by a violent distension of the vessels of the choroides, where, he thinks, varices may easily arise, in consequence of the weak resistance of that membrane. In this manner, the filaments of the retina suffer pressure, and the rays of light are broken. Under these circumstances, if prompt assistance be not afforded, total and frequently incurable blindness may be the consequence. Schmucker met with an irremediable amaurosis of this kind, in a young man, twenty-six years of age. When the patient made application for advice, he had been blind a year. Before he lost his sight, he remarked, that, after any violent emotion, his sight at first grew weak, and that objects afterwards appeared double. When his circulation was at all hurried, he saw black spots before his eyes, and at length was quite blind. The vessels of the choroides were as large as if they had been injected with wax, and every kind of surgical assistance proved ineffectual. (*Vermischte Chir. Schriften*, b. ii. p. 12. &c, 8vo. Berlin, 1786.) In some cases, double vision only occurs, when the patient looks at objects with both eyes, and it ceases as soon as he shuts either the diseased or the sound eye. In the last of these circumstances, double vision originates from the deviation of the unsound eye from the axis of sight; but, in the first instance, it arises from the morbid state of the retina itself of the diseased eye. For the purpose of distinguishing both these examples of diplopia from every other species of symptomatic double vision, Beer applies to them the name of *diplopia nervosa*. A degree of squinting, *strabismus*, therefore, is a common symptom of incipient amaurosis, particularly when only one eye is affected; for this always deviates more or less from the axis of vision. It is owing to this loss of correspondence, that persons, affected with an imperfect amaurosis of one eye, often mistake the relative distance of objects, and frequently see them reflected. (*Travers's Synopsis*, p. 170.) It is less usual for imperfect amaurosis to be accompanied with what Beer terms obliquity of the eye (*Luscitas*); either a paralysis, or a ceaseless, irregular action of one or more of the muscles of the organ, being evidently a condition of this symptomatic appearance. (See *Beer, Lehre von den Augenkrankheiten*, b. ii. p. 427.)

Beer has often met with patients labouring under imperfect amaurosis, who could plainly distinguish all objects which were not very small; but saw them of a different colour from their real one; for instance, yellow, green, purple, &c. *Visus coloratus erupsia.*) He had under his care an amaurotic woman, who at midday could discern even the smallest objects in a strong light, but they all appeared yellow, though no marks of jaundice were perceptible.

Sometimes, in the early stage of amaurosis, all objects appear distorted, bent, shortened, and, in rarer instances, inverted. (*Visus disfiguratus; Metamorphosia.*) Thus the flame of a candle appears very long, but all awry. This is said by Beer to be constantly an unfavourable omen, as the cause of it lies in the brain itself.

Imperfect amaurosis is sometimes attended with considerable shortsightedness (*Myopia*), and sometimes with the opposite affection (*Presbyopia*), an infallible proof that essential changes have happened either in the transparent media or in the muscles of the eye.

Many patients, when first attacked with amaurosis, every where testify a partiality to a great quantity of light, employing several candles at night, and sitting in the day-time with their backs against a sunshiny window, in order to let whatever they are reading have a very strong light upon it. This symptomatic appearance of incipient amaurosis is termed by Beer, *Lichthunger*.

Amaurosis may take place in an instant, even so as to be attended with entire blindness; or it may come on quickly, that is, it may be complete in a few days or weeks; or, lastly, what is most frequently the case, it may be produced gradually, and several years elapse before it attains its utmost degree; circumstances of great moment in the diagnosis and treatment.

The type, which the disease assumes in its course and development, is also subject to great variety, and claims the utmost attention; for amaurosis may either be *permanent* or *temporary*. It is sometimes *intermittent*, making its appearance at regular or irregular intervals. In certain examples, it prevails at particular times, commonly all day, till a certain hour; or from one day till the next; or at a stated time every month. The attacks sometimes take place at indeterminate periods. In particular cases, another morbid affection is associated with the impairment of sight. Richter mentions a man, who became blind at twelve o'clock in the day, when the upper eyelid used to hang down paralytic. The attack always lasted twenty-four hours. On the following day, at twelve o'clock, the sight used to return, and the patient then suddenly regained the power of raising the upper eyelid. He would continue thus able to see for the next twenty-four hours. Whenever he took bark, the disease was regularly doubled; that is to say, the man then alternately remained blind forty-eight hours, and recovered the power of seeing for only twenty-four. In another patient, cited by the same writer, the aqueous humour, during the blindness, always became discoloured, whitish, and turbid; but its transparency regularly returned on the cessation of the attack. According to Richter, *periodical* amaurosis commonly depends upon irritation affecting the digestive organs, the stimulus of worms, or irregularity in the menstrual discharge. Sometimes it is plainly a symptom of a confirmed ague, the patient being attacked with an ordinary intermittent, and blind during each paroxysm, but always regaining his sight as soon as each fit is over (*Anfangsgr. der Wundarnz.* b. iii. kap. xiv.) Beer believes, that periodical amaurosis is chiefly observed in chlorotic, hemorrhoidal, hysterical, and hypochondriacal subjects. *Day-blindness* (*Cœcitas Diurna; Nyctalopia*) and *night blindness* (*Cœcitas Crepuscularis; Hemeralopia*) are nothing more than cases of periodical amaurosis. To these cases, Richter's etiology will not apply; the causes being entirely of another kind. But sometimes the frequently recurring form of the disease confines itself to no determinate type; and, on account of its irregularity, it is then termed by Beer, *Amaurosis Vaga*, which, he says, is principally met with in persons liable to hysteria, hypochondriasis, convulsions, or epilepsy. Periodical amaurosis, after remaining uncured a certain time, often becomes *permanent.* (*Beer, Lehre, &c.* b. ii. p. 429.

The amaurosis, commencing with morbid irritability of the retina and photophobia, is described by Beer as having two stages: during the first, the patient never becomes blind; the eyesight not being lost till the end of the second stage. The disease always forms with great quickness, so that the limits between the two stages are frequently very indistinct.

The first stage commences with a peculiar sensation of fulness in the eyeball, joined with continually increasing, violent, and annoying luminous appearances, and a remarkable weakness of sight. These symptoms are soon followed by a stupifying, constantly increasing headache, during which the power of vision manifestly diminishes, without the slightest defect being perceptible, either in the eye itself, or its surrounding parts. The patient, however, is always of an athletic constitution, or has symptoms of general or local plethora, or a phlogistic diathesis. This observation coincides with the view which I entertain of this part of the subject, namely, that the amaurosis beginning with irritability of the organ and photophobia, originates generally from an inflammatory affection of the retina. A different opinion, however, is sometimes expressed. "This condition of photophobia, (says Mr. Middleton) is wholly unconnected with retinitis, and, although it is relieved by protecting the eye from bright light, does not restore to the organ perfect vision: the sight is, in fact, impaired in a greater or lesser degree, although from the degree of intolerance of light which is present, it might be inferred, that the sensibility of the retina was increased in a manner which was wholly inconsistent with the existence of impaired and cloudy vision." (See *R. Middlemore on Dis. of the Eye*, vol. ii. p. 257.)

Upon the advance of the disorder into its second stage, the headach becomes irregular, being less violent at some periods than others; the patient feels as if there were before his eyes a thick net, or gauze, which, in a bright light, appears quite black, but, in the shade, fiery and shining. This net or gauze, when there is any temporary determination of blood to the head and eyes, as in straining at stool, is immediately rendered considerably more dense; and when such determination of blood is often repeated, or long maintained, the density at length remains much greater than before, and consequently, the patient suddenly grows more blind, and is very quickly entirely bereft of vision. This complete loss of sight, in the second stage, if efficient assistance be not given, is ultimately produced by the progress of the disease, even without any accidental determination of blood, though never quite suddenly. At last, all power of discerning the light is abolished, under incessant stupifying headachs, which are sometimes weaker, sometimes stronger, and attended with a sensation as if the dimensions of the eye were increased, and, indeed, it really feels harder than in the healthy state.

Sometimes amaurosis originates with symptoms of weakness and diminished irritability. The sight is cloudy, and the patient finds that he can see better in a light than a dark situation. He feels as if some dirt, or dust, were upon his eyes, and is in the habit of frequently wiping them. His power of vision is greater after meals than at the time of fasting. His sight is always plainer, for a short time after the external use of tonic remedies, such as hartshorn, cold water, &c. Richter informs us of a person who was nearly blind, but constantly able to see very well, for the space of an hour after drinking champagne wine. He also mentions a woman entirely bereft of sight, who was in the habit of having it restored again, for half an hour, whenever she walked a quick pace up and down her garden. He likewise acquaints us with the case of a lady, who had been blind for years, but experienced a short recovery of her sight, on having a tooth extracted. (*Anfangsgr.* &c. b. iii. kap. 14.)

Whether the benefit arose from the stimulus of the operation, as Richter seems to imply, or from the removal of an irritating cause, doubts may be entertained. A similar fact is recorded by Mr. Travers, who says, that he has seen an incipient functional amaurosis distinctly arrested by the extraction of a diseased tooth, when the delay of a similar operation had occasioned gutta serena on the opposite side two years before. (*Synopsis*, p. 299.)

When the disorder is accompanied with diminished sensibility in the eye in general, Beer coincides with Richter, respecting the temporary improvement of the sight after a nourishing meal, or drinking spirituous liquors; or when the patient's mind is elated with joy or anger, though such melioration of sight, it is true, is but of very short duration. (Also *Vetch on Dis. of the Eye*, p. 137.) On the other hand, it may be remarked, that every thing which tends to depress the passions and spirits, augments the imperfection of sight. Where marks of increased sensibility prevail, the abovementioned circumstances exercise a transient disadvantageous operation; the patient carefully retires from every strong light, and frequently shelters his eye with his hand, &c. (*Lehre von den Augenkr.* b. ii. p. 430.) Mr. Travers also knows patients, whose vision is benefited in a high degree, and others, in whom it is much deteriorated, by the quickened circulation of a full meal, and a few glasses of wine. The former, he says, are persons of spare and meagre habits; the latter, plethoric. (*Synopsis of the Diseases of the Eye*, p. 157.)

According to Beer, this amaurosis, originating with diminished sensibility of the organ, usually comes on very slowly, and does not exhibit the two very different stages peculiar to the opposite case. It also invariably commences with the visus reticulatus, or nebulosus, without any alternation with a blinding glare of light; and the eyesight is sometimes considerably better, and sometimes weaker, which always depends upon the accidental operation of the above internal or external circumstances. The melioration of the eyesight never continues long, while the diminution of it not only remains, but gets worse and worse. It is not at all uncommon for this species of amaurosis to make its appearance as a night blindness, because common artificial light is much too feeble to make due impression upon the diminished sensibility of the optic nerve, and consequently these patients always show a partiality to a strong light. To such weak-sighted individuals, the flame of a candle, or the moon, appears as if covered by a dense veil, with an expanded halo round it of various colours. There is no complaint made of pain in the head or eyes; and no sensation of fulness or weight is experienced in the eyeball; much less are there any signs of the disease in the structure and form of the eye, or in the action of its irritable textures; but, when it has been long complete, it is usually conjoined with a debilitated habit.

Amaurosis either presents itself as a genuine uncomplicated affection, or, at least, with the appearance of such a form of disease of the eye, depending solely upon a morbid state of the optic nerve, and cognizable by a diminution, or complete abolition, of the power of vision; or the disease is co-existent with other diseased appearances, either in the eye, its vicinity, or some others organs at a distance from the eye, or in the general constitution. These appearances merit the most earnest consideration, because they are for the most part connected with the cause of amaurosis. According to this statement, then, there is a *genuine local amaurosis,* and a *complicated amaurosis,* which last may be either *local* or *general,* or of both descriptions together, and therefore named by Beer, *perfectly complicated.* (Vol. cit. p. 431.)

In the simple uncomplicated species of amaurosis, all morbid appearances are absent, which might be produced in the amaurotic eye by any one preternatural change in the texture, form, or state of that organ. Hence we are obliged to trust almost exclusively to the patient's assertion, that his sight is bad, or quite gone; and not unfrequently it is necessary, especially in judicial cases, to employ political artifices, in order to determine whether such assertion be true, particularly when the patient affirms that the blindness is restricted to one eye. Secondly; when amaurosis is indeed nearly or quite formed in one eye, a slight degree of strabismus is at most perceptible, arising from the circumstance of the patient's not fixing the eye affected upon any object. This degree of strabismus is noticed by Ackermann and Fischer as the surest sign of amaurosis. (See *Klinische Annalen von Jena,* st. i. p. 144.) And it is particularly pointed out by Richter as an invariable attendant upon amaurosis. The patient, says he, not only does not turn either eye towards any object, in such a manner that the object looked at is in the axis of vision, but he does not turn both his eyes towards the same thing. This was regarded by Richter as the only symptom which we can trust, where implicit confidence should not be put in the mere assurance of the patient that he cannot see, while all the coats and humours of the eyes present their natural appearance. (See *Anfangsgr. der Wundarzn.* b. iii. kap. 14.) This observation is interesting to the military surgeon, amaurosis being a common affliction of soldiers, many of whom, however, endeavour to avoid service by pretending to labour under a disqualification which they well know does not necessarily produce any very considerable alteration on the natural appearance of the eye. Thirdly; while the disorder is only in the stage of amblyopia, the patient always complains of continually multiplying muscæ volitantes, or of the visus reticulatus, or nebulosus. Fourthly; luminous forms appear before the eyes, especially in the dark, even when the patient is entirely blind. Fifthly; the decrease of vision goes on to complete blindness, without any material interruption or retrogression. Sixthly; when only one eye is quite blind, and the eyesight on the other side is perfectly undisturbed, there is one infallible symptom of this amaurosis, namely, *if the sound eye be very carefully covered, the pupil of the blind one immediately expands, and the iris becomes quite motionless, notwithstanding the diseased eye be exposed to the strongest light possible.* However, this criterion is mostly wanting, because the amaurosis, unattended with any perceptible defect, except loss of vision, is seldom confined to one eye, but usually affects both. (See *Lehre von den Augenkr.* b. ii. p. 481-82.)

Mr. Travers divides amaurotic affections into two classes, the *organic* and the *functional.* The first comprehends alterations, however induced, in the texture or position of the retina, optic nerve, or thalamus. The second includes suspension or loss of function of the retina and optic organ, depending upon a change, either in the action of the vessels, or in the tone of the sentient apparatus.

As causes of organic amaurosis, this author enumerates: 1. Lesion, extravasation of blood, inflammatory deposition upon either of its surfaces, and loss of transparency of the retina. 2. Morbid growths within the eyeball, dropsy, atrophy, and all such disorganisations as directly press upon, or derange the texture of the retina. 3. Apoplexy, hydrocephalus, tumours or abscesses in the brain, or in or upon the optic nerve or its sheath, and thickening, atrophy, absorption, or ossification of the latter. As causes of functional amaurosis, Mr. Travers specifies: 1. Temporary determination; vascular congestion, or vacuity, as from visceral or cerebral irritation; suppressed, or deranged, or excessive secretions, as of the liver, kidneys, uterus, mammæ, and testes; various forms of injury and disease; and hidden translations of remote morbid actions. 2. Paralysis idiopáthica, suspension or exhaustion of sensorial power from various constitutional and local causes; from undue excitement or exertion of the visual faculty; and from the deleterious action of poisons on the nervous system, as lead, mercury, &c. From this description, says Mr. Travers, it will be understood, that organic, and many forms of functional amaurosis are incurable; and the functional, by continuance, lapses into the organic disease.

I particularly recommend to those who wish for further information on this part of the subject, to consult Mr. Middlemore's account of the pathological condition of the retina, optic nerve, brain, certain nerves, and various parts of the system, in explanation of the causes of amaurosis. (*On Dis. of the Eye,* vol. ii. p. 247.)

Functional amaurosis is subdivided by Mr. Travers into, 1st, the *Symptomatic,* or that which is only a symptom of some general disease, or disorder of the system; as, for example, plethora, or debility: 2dly, the *Metastatic,* or that produced by the sudden translation of the morbid action from another organ of the body; as, for example, from the skin, the testicle, &c. 3dly, the *Proper*, or that which depends upon a peculiar condition of the retina; as, for example, the visus nebulosus, muscæ volitantes. (*Synopsis*, p. 139—155.)

Mr. Lawrence does not consider the expression *functional* amaurosis to be of any practical utility; he argues, that the exact limits of the changes termed organic have not yet been determined. "We apply the epithet functional to those diseases which produce no changes recognizable after death. But we cannot infer from these cases, that no alteration had existed during life. The state of an organ, necessary to the correct execution of its function, is a living, not a dead condition; it requires, not merely a certain organization as we find after death, but a supply of healthy blood in a certain quantity, a natural state of nervous influence and sympathy, and perhaps other circumstances, not clearly understood. If all these conditions are combined, can we consider it possible, that the function should be disordered, or interrupted? If one or more should be altered, or wanting, can the disease be properly regarded as simply functional? Vascular congestion is an obvious deviation from the normal state of a part. If the retina, or any other organ, be said to be functionally disordered when its vessels appear twice as numerous and large as in the normal condition, the expression must be employed too loosely to convey any clear information." (*On Diseases of the Eye*, p. 489.) Mr. Middlemore conceives that the existence of irritation in some parts of the intestinal tube produces some change in the vascular department of the apparatus immediately subservient to vision, and that it does not excite an imperfection of vision by means of some undefined and indefinable irritation of a more or less protracted duration, which leaves the various organic conditions of the separate parts of that apparatus unaltered and unaffected; but, that it is not of a nature to induce any permanent change in the organic matter of parts, is proved by the perfection with which vision returns in many cases immediately after the temporary amaurotic attack. So far, then, it appears to Mr. Middlemore, that there is a certain similarity between *functional* or *sympathetic* amaurosis and *organic* or *structural*; but it must not be forgotten, that the former may, by continuance and establishment, terminate in the latter. (See *Middlemore on Diseases of the Eye*, vol. ii. p. 245.) It seems to Dr. Mackenzie, that amaurosis always results from an *organic cause*. The notion of a *functional* amaurosis, he conceives, must have arisen from the facts, that this disease is sometimes sympathetic, or arises in consequence of derangement of some remote organ; and that it is occasionally sudden in its attack, and, on the other hand, instantaneous in its departure. In sympathetic amaurosis, Dr. Mackenzie considers it as indisputable, that the loss of sight must depend on some organic change in the optic apparatus. Take, for example (says he), th eamaurosis which arises from the presence of worms in the bowels. This result is only occasional: the brain of perhaps not more than one out of a hundred affected with worms, is so susceptible of disease, that the irritation communicated to it from the bowels, through the great sympathetic nerve, is sufficient to excite it to that morbid condition which causes dilatation of the pupils and loss of vision; but, that the amaurosis, in these cases, is the consequence of any thing else than a certain morbid condition of the optic apparatus, seems to Dr. Mackenzie a proposition which scarcely deserves a serious refutation. Neither does he admit, when amaurosis occurs suddenly as a disease of relation, that it is independent of organic derangement in the optic apparatus, however indubitable it may be, that the first link in the chain of causes has existed in some remote part of the body. (*On Diseases of the Eye*, ed. 2. p. 902.) After all, however, with the qualifications and particulars annexed by Mr. Travers to his definition of the varieties of functional amaurosis, I see a perfect agreement between him and Mr. Lawrence in the pathological view of the subject: and the only question relates to the propriety of applying the term functional to particular forms of amaurosis. The least objectionable divisions of the amaurosis seem to the latter surgeon to be three, according as the disease proceeds from *affection of the sensorium*, or *of the optic nerve*, or of *the retina;* though he acknowledges, that the evidence during life leaves us sometimes in doubt, whether the case ought to be referred to one or another of these heads. Amaurosis (says he) may be induced by causes acting immediately on the nervous apparatus of the eye, such as excessive exertion of the organ, or a stroke of lightning; it may arise secondarily from sympathy between the nervous structure of the eye and some other previously affected organ, as from irritation of the stomach, or of the nerve of the fifth pair; or it may be a symptom of affection of the sensorium, more or less general. Hence, the distinction of the complaint into *idiopathic*, *sympathetic*, and *symptomatic*. (See *Lawrence on Dis. of the Eye*, p. 489.)

On the whole, genuine local amaurosis, that is to say, a diminution or total loss of the eyesight, unattended with any other apparent local or constitutional defect, may be said to be a rare case, the disorder being usually more or less complicated.

To the local complications, says Beer, belong cataract; glaucoma; a general varicose state of the eyeball (*cirsophthalmia*); exophthalmia; atrophy of the eye; spasms in the organ and surrounding parts; paralysis of one or more muscles of the eye (*ophthalmoplegia*); paralysis of the eyelids; ophthalmia in general, and internal ophthalmia in particular; a scorbutic bloodshot appearance of the eye (*Hypoema Scorbuticum*); and, finally, wounds or contusions of the eye, or adjacent parts. With these cases should also be mentioned that important disease, fungus hæmatodes of the eye. From this simple enumeration of local complications, one may see how frequently amaurosis is only a symptomatic effect of another disorder of the eye, with which it is conjoined, and how often it is connected with the same common causes, which pertain to another or several other diseases of eye.

Amongst the general complications, Beer enumerates those which are purely nervous: impairment of the health in various forms by infection, contagion, or miasmata; a bad habit of body; typhoid fevers, the amaurotic effect of which upon the eye the author of this work has frequently noticed; asthma; internal and external hydrocephalus; organic defects of the abdominal viscera; worms; chlorosis; consumption; old ulcers of the legs; organic disease of the brain and skull; complaints arising from pregnancy; hemorrhage,

&c. In these general complications, the casual connection between amaurosis and some remote disease of another organ, or of the whole constitution, cannot be mistaken; and we often see the disease of some other distant part from the eye suddenly or gradually diminish, and immediately appear again as a sympathetic action in the form of amaurosis, of which the most remarkable instance presents itself after the sudden healing of old ulcers of the legs. (*Beer, Lehre von den Augenkr.* b. ii. p. 433.)

One may consider as the only really inseparable symptom of amaurosis, that weakness of sight (*Ambiyopia*), or that complete blindness, in which neither with the unassisted nor assisted eye the least effect can be perceived in the structure and shape of the affected organ. But how rarely this essential symptom is met with alone, and how frequently it is obscured by some other defect in the structure and form of the eye, is proved by daily experience.

The incidental symptoms of amaurosis may consist in the faulty size and shape of the pupil. In many cases, the pupil is very much dilated, immoveable, and possesses its natural black colour, and usual transparency. This is the state of numerous cases, but there are many exceptions. Sometimes, according to Richter, in the most complete and incurable cases. the pupil is of its proper size, and even capable of free motion (*Turbés, Recueil Périodique, &c.* t. ii. p. 319.); and, occasionally, it is actually smaller and more contracted than natural. This aperture often continues extraordinarily large in the strongest light; but, in some instances, it is unusually small in every kind of light. (*Arrachard, Recueil Périod.* &c. t. i. p. 273.; *Richter, Anfangsgr. &c.* b. iii. p. 424.; *Beer, Lehre, &c.* b. ii. p. 435.) According to the latter writer, the pupillary edge of the iris rarely has its primitive shape, being generally more or less angular; either at some indeterminate point; or above and below, so as to resemble in some measure the pupil of the cat race; or towards the nose, or temple, so as to have some similitude in its form to the pupil of ruminating animals.

Frequently, not only the size and shape of the pupil are faulty, but its position is unnatural, being inclined either upwards or downwards, or outwards or inwards, but, most commonly, in a diagonal line between inwards and upwards; and in these cases the pupillary margin of the iris never describes a regular circle, but is more or less angular. (*Beer*, vol. cit. p. 436.)

The pupil of an eye, affected with amaurosis, frequently does not exhibit the clear shining blackness which is seen in a healthy eye. When the disease is an effect of hydrocephalus, and occurs in a young subject, the pupil presents its natural black hue; but in elderly subjects, it is rarely the case that some degree of glaucoma does not accompany amaurosis. (*Mackenzie*, ed. 2. p. 908.) In general, the pupil is of a dull glassy, hornlike blackness, which symptom alone is frequently enough to apprize a well-informed practitioner of the nature of the disease. It is, in the words of Mr. Travers, "little more than the healthy appearance of the humours in the eye of a horse." (*Synopsis*, p. 146.) Sometimes the colour of the pupil has an inclination to green; while, in other examples, this aperture seems to be dense, white, and cloudy, so that the complaint might easily be mistaken for the beginning of a cataract. This error, into which inexperienced surgeons are liable to fall, may generally be avoided by attention to the following circumstances. The misty appearance is not situated close behind the pupil, in the place of the crystalline lens, but more deeply in the eye. Nor is it in proportion to the impairment of sight, the patient being quite blind, while the misty appearance is so trivial, that, if it arose from the opacity of the crystalline lens, it could at most only occasion a slight weakness and obscurity of vision; at the same time, Richter acknowledges that it must be more difficult to avoid mistake when a beginning amaurosis is accompanied with this cloudiness of the eye, and, consequently, when the degree of blindness seems to bear some proportion to the degree of mistiness in the pupil. However, in this case, he maintains that the true nature of the disease may generally be known by comparing the ordinary symptoms of the two diseases. (*Anfangsgr.* b. iii. p. 14.) And, according to Beer, when the pupil is of a true dark gray, or greenish gray colour, a lateral inspection of the eye will show plainly enough that the cloudiness is in the vitreous humour or behind it. Sometimes the pupil appears reddish, quite red, or of a yellowish white colour (*Lehre von den Augenkr.* b. ii. p. 436.); while, in other cases, the interior of the eye, a good way behind the pupil, seems white, and a concave light-coloured surface may be observed, upon which the ramifications of blood-vessels can be plainly seen. In particular instances, this white surface extends over the whole back part of the eye, while, in other cases, it only occupies a half or a small portion of it. This peculiar appearance has been ascribed to a loss of transparency on the retina itself, and a consequent reflection of the rays of light. (*Haller. Element. Physiol.* t. v. p. 409.) Mr Travers inclines to the opinion, that it arises from a deficient secretion of the choroid pigment, a preternatural adhesion betwixt the choroid coat and the retina, and a discoloration or resplendent appearance of the latter from this cause. (*Synopsis*, p. 148.)

A whiteness behind the pupil sometimes originates from the diseased mass, which, in fungus hæmatodes of the eye, grows from the deeper part of this organ, and gradually makes its way forward to the iris, attended with total loss of sight. Putting out of present consideration the change of colour within the eye, produced by fungus hæmatodes, the other palish changes behind the pupil are not confined, as Kieser supposes, to very old cases of amaurosis, because the alteration is described by Schmucker as taking place especially in examples the formation of which was quite sudden (*Vermischte Chir. Schrift.* b. ii.); and Langenbeck has recorded cases in which the same appearance happened in the early stage of the disease. (*Neue Bibl.* b. i. p. 64, &c.)

The strongest criterion between amaurosis and incipient cataract, and one most to be depended upon in practice, is the difference which the flame of a candle exhibits in the two affections. In incipient cataract, it appears as if it were involved in a generally diffused thin mist, or white cloud, which increases with the distance of the light; but, in amaurosis, a halo, or iris, appears to encircle or emanate from the mist, the flame seeming to be split when at a distance. (*Stevenson on the Nature, &c. of Amaurosis.* Lond. 1821.)

If the pupil is *very much* dilated, if its mobility is *nearly* destroyed, if scintillations are present, and if the patient has recently been exposed to the operation of circumstances calculated to induce atonic amaurosis; then the decision that the case is of the latter kind is free from difficulty. (See *R. Middlemore on Dis. of the Eye*, vol. ii. p. 270.) This gentleman is satisfied, that the only circumstances, which can render it difficult to distinguish cataract from amaurosis, are, when mere atony of the retina, or atrophy of the optic nerve, *commences*, and especially, when either of these morbid states supervenes to a cloudy state of the pupil; and, in every such instance, where the slightest doubt exists, he recommends the eye not to be actively exerted.

For additional observations on the distinctions between incipient cataract and amaurosis and glaucoma, see *Cataract* and *Glaucoma*.

Besides the above appearances in the pupil itself, and in the pupillary margin of the iris, Beer adverts to several important phenomena with respect to the motion of the iris. Sometimes the iris moves inertly, and frequently not at all, though the light be strong, and the upper eyelid be rubbed over the eyeball. While, in other examples, a very moderate light will bring on such a rapid contraction of the iris and closure of the pupil as are never witnessed in a healthy eye.

We have also the authority of Richter for asserting, that, in particular instances, the iris not only possesses the power of motion, but is capable of moving with uncommon activity, so that, in a moderate light, it will contract and nearly close the pupil. (*Anfangsgr. der Wundarzn.* b. iii. p. 424. ed. 1795.)

Two or three remarkable instances of the active state of the iris, in cases of amaurosis, were some years ago shown to me by Dr. Albert, then staff surgeon at the York Hospital, Chelsea, and I have since seen other similar cases. Most of the patients in question had not the least power of distinguishing the difference between total darkness and the vivid light of the sun, or a candle placed just before their eyes. Janin sometimes found the pupil capable of active motion in this disease, and Schmucker twice noticed the same fact. An example of complete amaurosis, with perfect motion of the irides, is recorded by Mr. Lawrence. It was attended by violent pains in the head, and proved incurable. (*On Diseases of the Eye*, p. 494.)

Such cases, Mr. Travers thinks, can only be explained by concluding the organ to be sound, and the cause of the amaurosis remote, or external to it. Thus, says he, in a case of circumscribed tumour, compressing the left optic nerve, immediately behind the ganglion opticum, although the blindness was complete, the iris was active. In two young ladies, in whom the eyes, as in the former case, were perfect, and the blindness complete, the iris was even vivacious; and there was the strongest presumptive evidence, from the symptoms, that the amaurosis was in the cerebral portion of the nerve. (*Synopsis*, p. 188.) Sometimes, when the retina of each eye is equally insensible to light, and the amaurosis of both eyes complete, the iris of each eye will be differently acted upon by the light, so that one pupil will be larger and its motions more lively than those of the other. Mr. Middlemore has seen several persons, who had amaurosis in a decided form in one eye, and only in a very slight degree in the other, in whom the mobility of the pupil, as tested in various ways, was much more considerable in the most diseased eye. The irritability of the iris, and the sensibility of the retina to light, do not, therefore, always correspond. (See *R. Middlemore on Dis. of the Eye*, vol. ii. p. 255.)

In some anomalous cases, when the strength of the light is suddenly increased, the pupil expands with more or less celerity.

It is observed by Mr. Travers, that if the retina be opaque, compressed, or unsupported, the iris mechanically disordered, or the ciliary nerves palsied, the pupil is inactive, independently of the state of vision. In the first of these cases, it is evident that the sight will be lost; but we continually see useful vision combined with the second and third, as after operations, in which the iris has been half destroyed, or has become preternaturally adherent, or in malformations, where it is half wanting; and in paralysis of the ciliary nerves, accompanying ptosis. (*Synopsis*, p. 188.)

Frequently, in amaurosis, when the sight of only one eye is lost, and the other retains its full power of vision, not the slightest defect can be discovered as long as the patient keeps both of them open; but, the instant the sound eye is completely covered, the iris becomes perfectly motionless, its pupillary margin assumes an angular shape, and the pupil expands, being sometimes evidently drawn towards the edge of the cornea. (*Beer, Lehre von den Augenkrank.* b. ii. p. 438.) This demonstrates the difference between the independent and the associated action of the iris.

Besides the above appearances of the pupil and iris, amaurosis is attended with other characteristic phenomena, which occur under certain circumstances, in the form, texture, and state of other parts of the eye, and adjoining organs. Thus, the patient often complains of a peculiar troublesome dryness of the eye, or of a sensation as if the eyeball were about to be pressed out of its socket; and, indeed, says Beer, one may sometimes hear a grating noise, and distinguish a fluctuation in the orbit behind the eyeball, when this organ is pressed upon by the finger, or moved in various directions, though neither its circumference be enlarged, nor any tendency to exophthalmia be really present. Nor is it very uncommon to find the affected eye preternaturally hard, soft, or even quite flaccid; but it is less common to find the dimensions of the globe of the eye increased, or the organ affected with atrophy. (*Beer*, vol. cit. p. 438.)

However, in organic amaurosis, a peculiar bluish gray tint of the sclerotic coat is frequently remarkable; and sometimes even a degree of bulging on one or more sides of the eye, or simply a loss of sphericity, its sides appearing flattened. A turgescence of the superficial vessels, especially of the long fasciculi of conjunctival veins, is likewise another symptom, frequently observed in organic amaurosis. (See *Travers's Synopsis*, p. 146.)

In this work are given the particulars of a dissection, in which a case of amaurosis was attended with a collapse of the retina from absorption of the vitreous humour.

Some of the principal morbid effects of amaurosis have been already described in speaking of the several defects of vision, which accompany an amaurotic weakness of sight. Besides these, however, there are others meriting attention. For instance, the patient feels in the eye and surrounding parts an irksome sensation, without any actual pain, and complains of a remarkable sense of fulness or weight in the organ. Amaurotic patients are also frequently attacked with sudden violent giddiness, usually ending in a considerable diminution of the eyesight, and sometimes in severe general headach. Occasionally they fancy that small atoms of dust are lodged under the eyelids, and are fearful of moving these parts, or the eye. It is also well known, that many persons become amaurotic while labouring under severe hemicrania, extending from, or to, the diseased eye; while, on other occasions, the most violent pains are confined, particularly to the region of the eyebrow, and have the appearance of being strictly periodical. In certain other cases, the pain is wandering, and shoots in every direction about the eyebrow. These painful feelings often precede the amaurotic blindness a considerable time, and often first take place when one or both eyes are already blind; but the pains and loss of sight are not unfrequently produced together. Lastly, some patients are met with, in whom the worst pains only last until the amaurosis is perfectly formed, when they gradually and permanently cease. In all these painful cases of amaurosis, the pain and the blindness chiefly depend upon the same cause, and one is seldom the occasion of the other. Sometimes amaurotic patients experience such violent pain, that they lose their senses, and grow delirious; but, in these cases, if we can credit the assertion of Beer, important morbid changes in the bones of the skull, or the brain itself, are invariably noticed after death. (See *Lehre von den Augenkr.* b. ii. p. 439.) In some amaurotic patients, lethargic symptoms may be remarked; in others, restlessness; and, more rarely, delirium in all its degrees, either as a transient or permanent affection.

According to the observations of Mr. Travers, pain in the forehead and temples is a precursory symptom of amaurosis, diminishing in proportion as the dimness increases. When the amaurosis is perfect, it usually ceases altogether, *if the disease has its seat in the eyeball.* But when the pain is severe, remits imperfectly, and is quickly rendered worse by exercise, it is usually connected with organic disease of the brain. In this case, derangement and torpor of the primæ viæ, loss of strength and flesh, disposition to stupor, occasional confusion of intellect, inaptitude to exertion, and paralysis of one or more muscles, will be concomitant symptoms. (*Synopsis, &c.* p. 167.)

Paralytic appearances may precede amaurosis, either in the vicinity of the eye, or in the muscles of the face, or in a distant situation, as the extremities. Sometimes they accompany the disease, and sometimes closely follow the weakness of sight, being not unfrequently the forerunners of a fatal attack of apoplexy.

In the same way, convulsive symptoms may be conjoined with amaurosis; and when they first occur in the complete stage of the latter disease, Beer pronounces them a very unfavourable omen for the patient's life.

Likewise, when in a case of perfect amaurosis, several of the other senses are affected; when the hearing and then the smell and taste, are lost, and afterwards the memory and other intellectual powers fail, the patient's speedy dissolution may be expected. (See *Lehre von den Augenkrankh.* b. ii. p. 441. Wien, 1817.)

In some cases, the cause is of a *local, direct,* and *mechanical* nature; such as the pressure of a tumour on the optic nerve. In others, it is of a *local,* but *vital* kind; such as a plethoric, or congested state of the blood-vessels of the brain, or eye. In a third set of cases, the cause is *general,* or *constitutional;* such as exhaustion, consequent to profuse or continued loss of some of the fluids of the body. (See *Wm. Mackenzie on Dis. of the Eye,* p. 901. ed. 2.)

Age cannot be considered a predisposing cause of amaurosis in the same degree that it is of cataract; for there are many more blind persons who have been deprived of their sight by amaurosis in their best days, than old persons thus attacked. Amaurosis spares no age — not even the new-born infant. Mr. Lawrence concurs in this statement, adding his belief, however, that amaurosis is most frequent at or after the middle period of life, especially about the cessation of menstruation in females, and the corresponding age in the male. (*On Diseases of the Eye,* p. 517.)

The following statement, in relation to this part of the subject, appears correct:—"There are certain ages, at which, from particular circumstances, amaurosis is most commonly witnessed, and for the most part merely as a functional, or sympathetic affection. In the first place, it may be congenital, with or without being evinced by any defect in the form or the magnitude of the eye, or any of its parts, although the globe generally acquires under such circumstances a rolling or unsteady motion. Amaurosis may be produced by hydrocephalus, which disease occurs most frequently in children; by convulsions; and by the irritation connected with dentition, or by the presence of worms in the stomach or intestines. These are the circumstances associated with very early life, with which amaurosis is most commonly connected. At the period of puberty, it is sometimes induced by vitiated habits, and by certain conditions of, and changes in, the genital system. Again, the period of pregnancy and suckling are favourable to its origin; the former, by the pressure of the gravid uterus on the large venous trunks; and the latter, by enfeebling the system generally, and very probably also by over-exciting and deranging that sympathy which exists between the uterus, the mammæ, and the retina, and with the precise nature of which we are not fully acquainted. The final cessation of menstruation is the next season at which amaurosis is most likely to take place; and, lastly, extreme age is a strong predisposing cause of amaurosis." (See *Middlemore on Dis. of the Eye,* p. 252.)

Four forms of *congenital* organic amaurosis are noticed by Mr. Travers. One, in which the eye is preternaturally small, soft, and even flaccid; the iris tremulous, and not influenced by belladonna; and the globe affected with tremor, and not subject to the control of the will. A second, depending on a deficiency of the pigmentum nigrum; the organ is tremulous, strong light produces uneasiness, and vision is dazzled and confused. The vessels of the choroid give the interior of the eye a deep red tinge. A third case is that in which the sclerotica so encroaches upon the cornea, that the latter is scarcely wider than the pupil. In the fourth kind of congenital amaurosis, described by Mr. Travers, the eyes move in concert, as if attracted by a faint perception of light; but the infant is blind: no marks of organic derangement can be seen; but the disease may be connected with a morbid state of the thalami, or optic nerve. (*Synopsis*, p. 153, 154.)

Neither do sex and race affect the frequency of the complaint; but dark eyes are sometimes alleged to be more disposed to amaurotic blindness than such as are light-coloured. According to Beer's experience, for every gray or blue eye affected with amaurosis, there are five and twenty or thirty brown or black ones thus diseased. L. Winslow, Weller, and Sanson likewise regard dark eyes as most subject to amaurosis. In this country, I believe, it is found, that the mere colour of the eye has not the influence here represented in predisposing to amaurosis. (See *R. Middlemore on Diseases of the Eye*, vol. ii. p. 252.)

More frequently than cataract, amaurosis is found to be a true hereditary disease; — this is so much the case, that most of the members of a family, for more than one generation, may lose their sight from amaurosis at a certain period of life. Beer was acquainted with more than one family in which this happened; and, what merits attention, the women of one of these families, down to the third generation, became completely and permanently blind from amaurosis on the cessation of the menses, while all the others, who had had children, were unaffected. But the males of this unfortunate family, who, as well as the females, have very dark-brown eyes, all seem to be weak-sighted, though none of them are yet blind. (*Lehre von den Augenkrankheiten*, b. ii. p. 443.)

In women, especially those with black eyes, the time when the menses stop is considered by Beer a likely period for the commencement of amaurosis.

According to the same writer, patients whose piles used to bleed periodically for a long time, but are now suddenly stopped, and whose eyes are dark, are very liable to amaurosis.

One of the less common causes of amaurosis is an idiosyncrasy, in relation to this or that sort of nutriment or medicine, or this or that particular state of the body. Here is to be reckoned the amaurotic weakness of sight, or the perfect amaurosis, which comes on at the very commencement of pregnancy, and subsides after delivery, but always attended with dyspepsia and insuperable vomiting. This species of amaurosis, however, should be carefully distinguished from that which sometimes first originates in the final months of pregnancy, and chiefly from strong and long-continued determination of blood to the head and eyes, particularly when the bowels are at the same time loaded, and the patient constipated. This latter case usually continues till after delivery; or, if the labour be tedious, difficult, and attended with considerable efforts, the blindness may first attain its complete form at the time of delivery, and not afterwards subside.

Beer saw a young Jewess, who, at the very beginning of her first three pregnancies, which followed each other quickly, regularly lost her sight, becoming completely amaurotic between the third and fourth months, and, on the two first occasions, she continued blind till after delivery; but, in the third instance, the power of vision never returned at all. (See also *Démours, Traité des Mal. des Yeux*, t. i. p. 380.) Beer twice had under his care another woman, who was attacked with amaurosis whenever she drank chocolate; but, upon leaving off that drink, she never afterwards had any complaint in her eyes.

The abuse of narcotic poisonous substances may induce amaurosis; as opium, hyoscyamus, belladonna, &c. Lead will do the same thing. Dilatation and a fixed state of the pupil follow the mere application of some narcotics to the skin; a circumstance of which we take advantage in the treatment of several diseases of the eye; but, it does not usually happen that belladonna and hyoscyamus, the substances employed in this way, produce any other effect than a degree of obscurity and dazzling, such as a great influx of light through a much dilated pupil might occasion. Taken internally, however, these and some other poisons of the same class, as stramonium, dulcamara, white hellebore, tobacco, opium, &c. cause more or less complete insensibility of the retina, along with mydriasis, or myosis. The blindness is often a very obstinate symptom, continuing a long while after disturbance of the intellectual functions has ceased. (See *Mackenzie on Dis. of the Eye*, p. 956. ed. 2.)

One not unfrequent cause of amaurosis is hysteria and hypochondriasis, with which must be mentioned disease of one or more of the abdominal viscera, especially the liver. (*Beer, Lehre, &c.* b. ii. p. 444—446.)

According to Richter, the remote causes of amaurosis may be properly divided into three principal classes, the differences of which indicate three general methods of treatment.

The first class of causes depends upon an extraordinary plethora and turgidity of the blood-vessels of the brain, or of those of the optic nerves and retinæ, upon which last parts a degree of pressure is thereby supposed to be occasioned. A considerable plethora, especially when the patient heats himself, or keeps his head in a depending position, will frequently excite the appearance of black specks before the eyes, and sometimes complete blindness. A plethoric person (says Richter), who held his breath, and looked at a white wall, was conscious of discerning a kind of network, which alternately appeared and disappeared with the diastole and systole of the arteries.

Richter thinks it likely, that the disease is thus produced, when it proceeds from the suppression of some habitual discharge of blood, from the neglect to be bled according to custom, the stoppage of the menses, and the cessation of hemorrhage from piles. In the same manner, the complaint may be brought on by great bodily exertions, which determine a more rapid current of blood to the head. Richter informs us of a man, who became blind all on a sudden, while carrying a heavy burden up stairs. He tells us of another man, who laboured excessively hard for three days in succession, and became blind at the end of the third day. Pregnant women, in like manner, are sometimes bereft of their sight during the time of labour. Schmucker has recorded a remarkable instance of this in a strong young woman, thirty years old, and of a full habit. Whenever she was pregnant, she was troubled with violent sickness, till the time of delivery, so that nothing would stop in her stomach. She was bled, three or four times, without effect. Towards the ninth month her sight grew weak, and, for eight or ten days before parturition, she was quite blind. The pupil of the eye was greatly enlarged, but retained its shining black appearance. She recovered her sight immediately after delivery, and did not suffer any particular complaints. Schmucker assures us, that he has been three times a witness of this extraordinary circumstance. (*Vermischte Chir. Schriften,* band ii. p. 6. ed. 1786.) Richter speaks of a person, who lost his sight during a violent fit of vomiting. Schmucker acquaints us, that it is not uncommon for soldiers, who are performing forced marches in hot weather, to become suddenly blind.

Beer also coincides with Schmucker, Richter, and others, in regarding, as a frequent cause of amaurosis, repeated and long-continued determinations of blood to the head and eyes, produced by various circumstances, viz. by pregnancy; a tedious and difficult labour; lifting and carrying heavy burdens, especially with the arms raised up; all kinds of work, in which the eyesight and intellectual faculties are intensely exerted, with the head bent forwards, and the abdomen compressed, as is the case with shoemakers, tailors, &c.; every sudden stoppage of natural or preternatural long-established discharges of blood, as that of the menses lochia, or hemorrhoids; the omission of habitual venesection at some particular season of the year; severe and obstinate vomiting; forced marches in hot, dry weather; scrofulous and other swellings of considerable size in the neck, pressing upon the jugular veins, and obstructing the return of blood from the head; the use of a pediluvium, or warm bath, the water of which is of high temperature; hard drinking; violent gusts of passion; frequent and obstinate constipation; and hard straining at stool. These causes are more likely to occasion amaurosis, in proportion as the individual is young and plethoric. The causes of that amaurosis which is characterized in its first stage by increased sensibility of the eye, and intolerance of light, are referred by Professor Beer to circumstances, which produce a long and repeated determination of blood to the head and eyes. (*Lehre von den Augenkr.* b. ii. p. 446. and 483, &c.)

Mr. Lawrence regards amaurosis, in its most frequent and important form, that which is seated in the eye itself, as generally the result of inflammation of the nervous structure; including under that phrase all degrees of increased vascular action, whether designated as fulness, turgescence, determination, congestion, or as inflammation in its more limited sense; and the usual consequence of inflammatory disturbance, that is, organic change, permanently destroying the function of the part. When, says he, we advert to the structure of the retina, we must suppose that it would be liable to such affections; we find it composed of minute ramifications of the arteria centralis retinæ, and, on this network of vessels, the nervous pulp is expanded. The state of the retinæ, when examined after death, in amaurotic eyes, accords with these views; it exhibits those changes which long-continued inflammatory disturbance would produce; it has been found thickened, opaque, spotted, buff-coloured, tough, and, in some cases, even ossified. The preceding doctrine is, however, judiciously qualified by its restriction to the disease as seated in the eye itself. The retina and optic nerve, Mr. Lawrence admits, with other surgeons, may be disordered sympathetically, as the stomach may be disordered, without any change visible on dissection.

The second class of causes are supposed to operate, by weakening either the whole body, or the eye alone, and they indicate the general or topical use of tonic remedies. In the first case, the blindness appears as a symptom of considerable universal debility of the whole system; in the second case, it is altogether local. Every great general weakness of body, let it proceed from any cause whatsoever, may be followed by a loss of sight. Amaurosis is sometimes the consequence of a tedious diarrhœa, a violent cholera morbus, profuse hemorrhage, and immoderate salivations. (See *Travers's Synopsis,* p. 144.) Richter informs us of a dropsical woman, who became blind on the water being let out of her abdomen. According to the same author, no general weakening causes operate upon the eyes, and occasion total blindness, so powerfully and often as premature and excessive indulgence in venereal pleasures. Mr. Lawrence does not coincide in some of the foregoing views. "Those," says he, "who have considered amaurosis to arise from debilitating causes, have considered that debility and atony of the nerve may be produced by all those circumstances which debilitate the system generally, such as loss of blood from profuse hemorrhage, diarrhœa, copious salivation, &c. I have never seen amaurosis produced by such causes. That great anxiety and grief may favour the occurrence of amaurosis, I am inclined to allow; for it is not improbable that severe impressions of that kind may produce inflammatory excitement in the brain or eyes; but I think we cannot, without more direct proofs, admit the influence of debilitating causes generally in the production of amaurosis. The most clear instance of any directly debilitating cause producing amaurosis, is that of protracted suckling."

The causes, which operate locally in weakening the eyes, are various. Nothing has a greater tendency to debilitate these organs than keeping them long and attentively fixed upon minute objects. But, however long and assiduously objects are viewed, if they are diversified, the eye suffers much less than when they are all of the same kind. A frequent change in the objects which are looked at, has a material effect in strengthening and refreshing the eye. The sight is particularly injured by looking at objects with only one eye at a time, as is done with telescopes and magnifying glasses; for, when one eye remains shut, the pupil of that which is open always becomes dilated beyond its natural diameter, and lets an extraordinary quantity of light into the organ. The eye is generally very much hurt, by being employed in the close inspection of brilliant, light-coloured, shining objects. Amongst the occupations enumerated by Mr. Travers as particularly exposing persons to amaurosis, are those of needleworkers, writers, draughtsmen, inspectors of linen and scarlet cloths, and of new bank notes; money counters; smiths; stokers in iron-furnaces and glass-houses; tavern-cooks; watchmakers, engravers, philosophical instrument makers, sea officers, &c. (*Synopsis,* p. 144.) They are greatly mistaken, says Richter, who think that they save their eyes, when they illuminate the object which they wish to see in the evening with more lights, or with a lamp that intercepts and collects all the rays of light, and reflects them upon the body which is to be looked at. Richter mentions a man, who, in the middle of winter, went a journey on horseback, through a snowy country, while the sun was shining quite bright, and who was attacked with amaurosis. He speaks of another person, who lost his sight in consequence of the chamber in which he lay being suddenly illuminated by a vivid flash of lightning. A man was one night seized with blindness as his eyes were fixed on the moon. Richter also expresses his belief, that a concussion of the head, from external violence, may sometimes operate directly on the nerves, so as to weaken and render them completely paralytic.

Beer corroborates the foregoing statement; for, he says, amongst the most frequent causes is to be considered every abuse of the eyesight, especially in dark-eyed persons, as a long and close inspection of one object, particularly with a microscope, when the thing examined is very brilliant, or reflects back much light into the eye. Hence, the view of jewels at night, and long journeys through snowy countries, &c. are conducive to the disease. In this respect, every kind of employment which strains the eyes much, and requires a strong reflected light, must be considered injurious. (See also *Travers's Synopsis*, p. 144.) Thus reverberating lamps, like Argand's; the view of a white wall illuminated with the sun's rays; and looking a long while at the moon, or more especially the sun, with the unassisted eye, are circumstances likely to bring on the disease. That a flash of lightning, especially when it suddenly wakes a person in the night-time out of a sound sleep, may produce an amaurotic amblyopia, in an irritable eye, or even perfect blindness, is a well known fact; and it is on the same principle, that going suddenly out of a dark bedroom, immediately after waking in the morning, into an apartment that commands an open extensive prospect, must be hurtful to an irritable eye, though the bad effects may only come on slowly. Here is also to be included every kind of over-irritation of the eye by light, as happens to typhoid patients, when they lie with their eyes open all the day in a large sunny chamber.

The cause of amaurosis is often suspected to depend upon local or constitutional debility, proceeding from impairment of the nerves in general, or of the nerves of the head, especially those of the forehead and eyebrow; either in consequence of falls from a considerable height, or of concussion with the weight of the whole body upon the heels; blows on the head; concussions or contusions of the eyeball. Some of the cases of amaurosis from blows on the temple or the eye, observed by Mr. Travers, were attended with signs of disorganization; some were superficially inflamed; and others presented no external appearance of injury. It is not always the eye on the struck side of the head that is affected. (*Synopsis, &c.* p. 152.) If we are to believe Beer, considerable direct weakness, leading to amaurosis, may arise from cholera, long-continued diarrhœa, salivation, and the incessant spitting of tobacco smokers; bleedings; injudicious tapping of the abdomen; excessive indulgence in venery, and the misemployment of issues. A general debility, which has the worst effect on the eyes, may also arise from long trouble, especially when the diet is poor and bad; also from a deficiency of proper food, long watching, or violent and sudden fright. The amaurosis following typhus, without any unusual irritation of the eye by light, Beer refers to general debility. (*Lehre von den Augenkr.* b. ii. p. 449.)

Like nervous deafness, amaurosis sometimes follows typhus and scarlet fever, and the various forms of acute constitutional disease. Mr. Travers has several times met with it as a consequence of infantile fevers. He observes, that it is also sometimes a consequence of chronic wasting diseases, in which organic changes interrupt the nutrition of the system. He has seen a rapid and severe salivation, instituted for a remote affection, and where no disease had previously affected the eyes, terminate in gutta serena of both. (*Synopsis*, p. 155.)

The susceptibility of the retina is conceived by Mr. Middlemore to be capable of being at once directly depressed, without going through the process of inflammation, in the same way as the nervous power of other parts of the system may be lowered or taken away by powerfully depressing and rapidly enervating agents. (*On Dis. of the Eye*, vol. ii. p. 247.)

With regard to the doctrine, that certain forms of amaurosis are diseases of debility, Mr. Lawrence expresses his disbelief in its correctness, and asserts that the only successful treatment of amaurotic affections is found, with few exceptions, to be variously modified antiphlogistic. (*On Diseases of the Eye*, p. 507.) Whether the amaurosis resulting from typhoid fevers, of which I have seen several instances, proceed from debility, or from too great a determination of blood to the head, may admit of dispute; but I conceive that, in many of such cases, tonic treatment is clearly indicated, if not for the eye itself, certainly for the generally enfeebled state of the health, with which the amaurosis is connected. Yet the doctrine, that fulness and congestion of the vessels originally lead to the amaurotic affection, may be more correct, than the theory which refers the blindness simply to weakness. However, as the amaurosis generally does not show itself till an advanced stage of fever, or that of great debility, and as it only recedes as the patient regains strength, it can hardly be considered as a case, in which any other treatment than tonic can be availing.

The third class of causes consists of irritations, most of which are asserted to lie in the abdominal viscera, whence they sympathetically operate upon the eyes. The observations of Richter, Scarpa, and Schmucker, all tend to support this doctrine. Many amaurotic patients are found to have suffered much trouble, and long grief, or been agitated by repeated vexations, anger, and other passions, which have great effect in disordering the bilious secretion, and the digestive functions in general. Richter tells us of a man, who lost his sight, a few hours after being in a violent passion, and recovered it again the next day, upon taking an emetic, by which a considerable quantity of bile was evacuated. A woman is also cited, who became blind, whenever she was troubled with acidities of the stomach. (See *Anfangs. der Wundarzn.* b. iii. kap. 14.) However, according to Beer, if the case from worms be excepted, imperfect amaurosis seldom depends upon disorder of the gastric organs (*Lehre von den Augenk.* b. ii. p. 456.); a very important difference from the statements of Schmucker, Richter, and Scarpa.

The close sympathy between the stomach and the eyes is well illustrated by a case referred to by Mr. Lawrence, where an amaurosis, with fixed pain over the eyebrow in a child, was not relieved by purging and other depletive measures: an emetic was at last given; and, under its action, a bead was rejected from the stomach, and the amaurosis immediately disappeared.

Amaurosis sometimes proceeds from mechanical irritation. A small shot pierced the upper eyelid, and lodged at the upper part of the right orbit, between the eyelid and eyeball, so that it could be felt externally. The patient shortly afterwards became blind in the left eye; but recovered his sight after the excision of the shot. (*Anfangsgr. der Wundarzn.* band iii. p. 439.) Injuries, or mere irritation of the branches of the fifth pair of nerves, have sometimes been followed by amaurosis.

Several constitutional disorders, especially gout, are sometimes thought to be concerned in the production of amaurosis. But whoever reads Beer's history of what he terms gouty amaurosis, will naturally doubt the correctness of the name. Mr. Lawrence affirms, that he has never seen gout or rheumatism occasion any tendency to affection of the nervous structure of the eye. It is not because amaurosis sometimes occurs in gouty or rheumatic constitutions, that the affection of the sight is necessarily of a gouty or rheumatic origin; for the fact merely proves, that such constitutions are not exempt from the risk of being attacked by disorders of the eye. Neither has Mr. Lawrence seen any cases, in which the origin of amaurosis could be referred to syphilis.

Respecting the causes of amaurosis, the following remarks by Beer claim attention. Various swellings in the orbit, as, for instance, encysted tumours, tophi, hydatids in the sheath of the optic nerve, may and must gradually produce complete amaurosis by their pressure upon the optic nerves and retina. Some of these cases are usually characterised by a protrusion of the eye from its socket. (See *Exophthalmia.*) Cases depending upon atrophy of the optic nerves are recorded by Dr. Monteith. (See *Weller's Manual.*) Mr. Langstaff has some interesting specimens of enlargement in front of the third ventricle, the parietes of which bulge so as to press upon the optic nerves, and thus to account for the amaurosis under which the patients laboured.

In the same manner, different morbid changes in the brain itself, and in the bones of the cranium in particular, may be the direct cause of amaurosis: for example, hydrocephalus internus, caries, and exostoses at the basis of the skull.

Just as amaurosis is frequently a pure symptomatic effect of various disordered states of the constitution, so may different morbid changes, occasioned in the eye by those states of the health, become the proximate cause of amaurosis, as cirsophthalmia, fungus hæmatodes, dissolution of the vitreous humour, glaucoma, &c.

One case, very analogous to amblyopia senilis, is believed to depend upon a diminution of the pigmentum nigrum, which secretion, in some individuals earlier and more considerably, in others later and in a slighter degree, recedes with other secretions of a different nature. (See *Beer's Lehre von den Augenkr.* b. ii. p. 451, &c.) Mr. Middlemore is certain, that he has met with cases in which a diminution in the quantity of the choroid pigment was the sole defect in the eye, and constituted the adequate and efficient cause of impaired vision. Cases of this description, he says, are for the most part attended by a contracted pupil, and great intolerance of light; and vision, though seriously impaired, is seldom destroyed. (*Op. et* vol. cit. p. 273.)

I think with Mr. Travers, that the history and concomitant appearances of amaurosis will often denote whether the case is *organic* or *functional.* "For example, diseased changes in the situation or texture of the eyeball, or in the brain, a hemiplegia, or partial paralysis, with other signs of apoplectic or hydrocephalic pressure, whether resulting from an injury of the head, or otherwise, or an acute deep-seated inflammation, whether accompanied by a visible opacity or not, point out the organic nature of the affection. I have seen (continues Mr. Travers) such an amaurosis produced by abscess in the cerebral substance, and by the medullary fungus of the cerebrum. On the other hand, I have known the following distinct sources of irritation produce functional amaurosis, viz. a wound of the scalp, caries of the skull, abscess and caries of the antrum maxillare, with excessive œdema of the integuments of the lids and cheek, a large abscess under the masseter and muscles of the cheek, and an abscess at the extremity of a molar tooth, while the crown of the tooth was sound. In all these cases, it is to be understood that the eye was sound, and the orbit was untouched by the disease of the parts in the vicinity, to which the amaurosis was clearly attributable. In like manner, an excessive use, or rather abuse, of the visual faculty, the disordered functions of the stomach, liver, uterus, &c., sudden and alarming depletion, excessive or obstinately suppressed secretions, difficult dentition, the presence of worms in the intestinal canal, and the deleterious effects of noxious agents upon the organ, or the system, are sufficiently obvious causes of the functional amaurosis." (*Synopsis, &c.* p. 142.) In general, recent cases afford a greater prospect of cure than others of long standing; and the same may be said with respect to examples, in which the eyesight is merely lessened and not completely extinguished.

In general, every amaurotic weakness of sight, and every completely formed amaurosis, are attended with the greatest probability of cure, where they began suddenly and were quickly developed. (*Beer, Lehre von den Augenkr.* b. ii. p. 454—456.) This observation perfectly coincides with the account given by Schmucker, who says that many of these suddenly formed cases fell under his notice, and were more easy of cure, than when the disorder had come on in a more gradual way. (See *Vermischte Chir. Schriften,* b. ii.) It also agrees with what Mr. Travers has stated, namely, that slow and steadily progressive cases of amaurosis are more to be apprehended in the result, that is, are less tractable, than either the sudden, or the rapidly advancing disease, supposing all to be alike free from unequivocal signs of organic change. (*Synopsis,* p. 298.)

Respecting suddenly produced cases, Mr. Lawrance holds out less encouragement than the preceding authorities. The prognosis, he says, is doubtful, and rather unfavourable than otherwise, as to the complete recovery of vision, if the affection, even in its most recent state, should have produced complete insensibility of the retina. He thinks we should speak doubtfully of the result in the case of complete insensibility to strong light, even if it had only lasted twenty-four hours. He considers it difficult to say in what number of days, or weeks, we should give up all hopes of recovery. In the supposed case of total insensibility, or even of a near approximation to it, there would be more ground for apprehension, than hope, at the end of a week, though sight is sometimes restored under these circumstances; but the lapse of a few weeks, without improvement, makes the case hopeless.

If amaurosis be partial, and the case seen early, Mr. Lawrence says a complete cure may be expected. He thinks favourably of the event when amaurosis takes place in conjunction with chronic internal inflammation, or when it is evidently caused by active congestion in the head or eye; for that can be removed by suitable treatment. A similar judgment is delivered by Mr. Middlemore: when the case is recent, takes place in young persons, and is evidently produced by vascular plethora, he says the prognosis is favourable, because the remaining degree of vision proves, that no important structural change has yet occurred, and the plethoric state of the system can be removed. (See *R. Middlemore on Dis. of the Eye*, vol. ii. p. 273.)

When one eye has been completely bereft of sight by amaurosis, and the surgeon can find out little or no cause for the infirmity, there is strong reason for apprehending that the other eye will, sooner or later, become blind. To this fact the exceptions are rare.

According to Beer, the idea entertained by some writers is not built upon experience, that amaurotic patients, in whom the iris is still moveable, and the pupil not much dilated, are more easily and frequently cured than others in whom the iris is perfectly motionless, and the pupil exceedingly dilated. For sometimes, during the treatment, or even spontaneously, the iris, after being quite immoveable, recovers its powers of motion, yet the patient may not, at the same time, regain the slightest degree of vision; and, on the other hand, many cases of perfect amaurosis are cured, without the iris recovering any of its mobility, and the pupil remains dilated during the remainder of the patient's life. (*Lehre von den Augenkr.* b. ii. p. 458.) Richter also states that an amaurosis may be cured, which is attended with a pupil extraordinarily dilated, and entirely motionless; and sometimes the disorder proves incurable, notwithstanding the pupil is of its proper size, and capable of motion. The pupil sometimes recovers its moveableness, in the course of the treatment, although nothing succeeds in restoring the eyesight. (*Anfangsgr. der Wundarzn.* b. iii. p. 424. 8vo. Gött. 1795.) However, the continuance of the perfect mobility of the pupil is set down by Mr. Middlemore as a favourable symptom; but he would not pronounce a case hopeless in which its mobility was entirely lost. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 262.)

In some rare instances, amaurotic blindness has been cured by some apparently accidental, or indeed morbid effect, without any assistance from art; by hemorrhage from the nose, an intermittent fever, a blow on the head, &c. Beer operated successfully upon both eyes of a patient with cataracts, which had been previously depressed too far against the retina, so that their pressure gave rise to amaurosis, which, after continuing eight years, was suddenly removed by the patient's accidentally falling out of bed, and pitching upon the top of his head. (*Lehre von den Augenkr.* b. ii. p. 458.)

The following observations, made by Beer respecting the prognosis, cannot fail to prove interesting. There is a species of amaurosis which gradually diminishes of itself; for instance, that which arises from hard drinking, or the effect of narcotic poisons, belladonna, opium, hyoscyamus, &c.

Sometimes imperfect amaurosis goes away without any assistance from art, in consequence of the accession of some other disease, as an eruption, a discharge of matter from the ear, bleeding from piles, return of the menses, &c.

In most cases, when the surgeon is so fortunate as to cure amaurosis, there still continues, for life, a considerable degree of amblyopia, more especially if the amaurosis has been complete.

Sometimes, by successful treatment, vision is in a great measure, or even entirely, restored in one eye, yet the other remains completely blind; or one eye sees again much sooner than its fellow, although they were both affected together with an equal degree of blindness.

It often happens that, though a material degree of vision returns in the course of the treatment, the faculty is restricted to a circumscribed point of the retina, so that the patient is enabled to see objects plainly only when they are held in a particular direction before him; while, in other directions, they are either quite invisible, or very indistinct. (*Beer, Lehre von den Augenkr.* b. ii. p. 459, 460.)

Amaurosis, following an injury of the supraorbitary nerve, ordinarily resists every endeavour made to relieve it, and this whether it come on directly after the blow, or some weeks subsequently to the healing of the wound of the eyebrow; but it is not always incurable. One cure is recorded by Valsalva. (*Dissert.* 2. § 11.) Additional instances are reported by Hey (*Med. Obs. and Inq.* vol. v.); by Larrey (*Mém. de Chir. Militaire*, t. iv. p. 181.). Dr. Hennen met with one or two cases of amaurosis from wounds of the supra-orbitary nerve: the perfect division of the nerve produced at first no alleviation of the complaint, but after some time the eye partially recovered. (*Principles of Military Surgery*, p. 366.) According to Mr. Wardrop, it is only when this nerve is wounded or injured, and not divided, that amaurosis takes place; for the blindness may sometimes be cured by making a complete division of the trunk nearest its origin. (*Morbid Anatomy of the Human Eye*, vol. ii. p. 180.) Dr. Mackenzie conceives, that we should regard with doubt the alleged occurrence of purely sympathetic amaurosis from slight injuries of the fifth pair of nerves, and he suspects that, in all such cases, there is, in addition to the external injuries, either concussion of the eyeball, or disease within the cranium. (*On Dis. of the Eye*, p. 125. ed. 2.) No doubt this has sometimes been the fact; but not always. The origin of sympathetic amaurosis from irritation of other filaments of the fifth nerve, and the experiments of Vicq d'Azyr, tend to prove the reality of amaurosis from the cause in question. Vicq d'Azyr exposed and lacerated the frontal and superciliary branches of the fifth pair in various animals, and found that the injury was followed by amaurosis. (*Journ. Compl. des Sciences Méd.* t. xliv. p. 201. Paris, 1832.)

Perfect, inveterate amaurosis, attended with organic injury of the substance constituting the immediate organ of sight, says Scarpa, is a disease absolutely incurable. *Imperfect, recent amaurosis*, particularly that which is *periodical*, is usually curable; for it is mostly dependent upon causes which, though they affect the immediate organ of sight, are capable of being dispersed, without leaving any vestige of impaired organization in the optic nerve or retina.

When amaurosis has prevailed several years in persons of advanced age, whose eyesight has been weak from their youth; when it has come on slowly, at first with a morbid irritability of the retina, and then with a gradual diminution of sense in this part, till total blindness was the consequence; when the pupil is motionless, not circular, and not much dilated; when it is widened in such a degree that the iris seems as if it were wanting, and the margin of this opening is irregular and jagged; and when the bottom of the eye, independently of any opacity of the crystalline lens, presents an unusual paleness, like that of horn, sometimes partaking of green, and reflected from the thickened retina, the disease may be generally set down as incurable. Kieser joins Scarpa in representing this alteration as an unfavourable omen, adding, that it only takes place in examples of long standing, and that, when it is considerable, the disease is incurable. Langenbeck differs, however, from both these authors, and particularly from Kieser, assuring us, not only that he has often seen this discoloration of the bottom of the eye in the early stage of amaurosis, but seen patients in this state soon cured. The cases which he has published, in proof of this statement, I have read with care, and find them completely satisfactory. Langenbeck agrees with other writers in imputing the appearance to a morbid change of the retina, and the treatment, which he prescribes, consists in the internal exhibition of the oxymuriate of mercury in small doses, and friction with mercurial ointment on the eyebrow and temple. (See *Langenbeck's Neue Bibl. für die Chirurgie*, b. i. p. 64—69, &c. Göttingen, 1815.)

Cases, attended with pain all over the head, and a continual sensation of tightness in the eyeball; or preceded by a violent, protracted excitement of the nervous system, and then by general debility, and languor of the constitution, as after masturbation, premature venery, and hard drinking; or connected with epileptic fits, or frequent spasmodic hemicrania; or which are the consequence of violent, long-continued, internal ophthalmia, may be set down as incurable. Nor can any cure be expected, when amaurosis proceeds from a direct blow on, or violent concussion of, the eye; foreign bodies in the eyeball; lues venerea, or exostoses about the orbit; or when it is conjoined with a manifest change in the figure and dimensions of the eyeball. The same judgment is applicable to complete amaurosis from long exposure of the eye to vivid light, or to causes which have been protracted in their injurious effects upon the retina. (See *R. Middlemore*, vol. ii. p. 274.)

Recent, sudden cases, in which the pupil is not excessively dilated, and its circle remains regular, while the bottom of the eye is of a deep black colour; cases unaccompanied with any acute, continual pain in the head and eyebrow, or any sense of constriction in the globe of the eye itself; cases which originate from violent anger, deep sorrow, fright, gastric disorder, general plethora, or the same partial affection of the head, suppression of the menses, habitual bleedings from the nose, piles, &c., great loss of blood, nervous debility, not too inveterate, and in young subjects, are generally curable. Amaurosis is also mostly remediable, when produced by convulsions or the efforts of difficult parturition; when it arises during the course, or towards the termination of acute or intermittent fevers; and when it is periodical. (*Scarpa, Osservazioni sulle Malattie degli Occhi*, cap. 20. Venez. 1802.) If amaurosis take place from the free administration of mercury, from protracted suckling, from profuse diarrhœa, or from a state of general debility, induced by other causes, the prognosis must depend upon our capacity to remove the debilitated state of the constitution, or its causes. In some cases, this is easy; in others, impossible. (See *R. Middlemore, Op.* cit. vol. ii. p. 273.)

According to Mr. Travers, it is rather the degree, than the nature and origin of the symptomatic functional amaurosis, that should in most cases influence our prognosis; yet the latter circumstances, it is equally clear, afford more or less encouragement, in proportion as the pre-existing states of disease ordinarily admit of relief, or not. Thus, says he, the amaurosis from gastric diseases, from plethora, from irritation, are all of them relievable, and, if treated at an early period, remediable. Whereas paralysis, the sequel of fever, or of epilepsy, or severe constitutional diseases, whether acute or chronic, or depending upon habitual cerebral congestions combined with organic visceral disease, or induced by the operation of noxious agents on the system, is a hopeless form of the malady. (*Synopsis*, p. 296.) I may remark, however, that various examples of recovery from amaurosis, induced by fevers, have fallen under my own notice.

In general, when the treatment proves successful, the return of vision is accompanied with a regression of the same characteristic effects, which were disclosed in the gradual advance of the disorder, viz. appearances as if there were before the eyes flashes of light, a cobweb, network, mist, or flaky substances. (*Beer, Lehre von den Augenkr.* b. ii. p. 460. Wien, 1817.)

Upon the commencement of the cure, there is also a return of the obliquity of sight; one of the most constant symptoms of imperfect amaurosis. This is a circumstance which Hey took particular notice of: he says, that it was most remarkable in those persons who had totally lost the sight in either eye; for in them the most oblique rays of light seemed to make the first perceptible impression upon the retina; and, in proportion as that nervous coat regained its sensibility, the sight became more direct and natural. (See *Med. Obs. and Inq.* vol. v.)

TREATMENT OF AMAUROSIS.

When amaurosis is to be fundamentally cured, not upon empirical, but scientific principles, all the causes of the disorder must be ascertained, and, if possible, removed, as in the treatment of every other complaint. How often, however, it is impossible to accomplish either the one or the other of these objects, must be clear enough from the preceding observations. Amaurosis is sometimes merely a symptom of another disease, and then attention must be directed to the primary malady, as illustrated in apoplexy, hydrocephalus, depressed fractures of the skull, and disorder of the intestinal or uterine functions.

If no particular circumstance can be assigned as the cause of amaurosis, the surgeon should act with great caution, and constantly bear in his mind, first, the constitution, sex, and age of the patient; secondly, his ordinary employments, and general mode of living; and thirdly, the principal morbid appearances under which the disease originated and was developed. (*Beer, Lehre von den Augenkr.* b. ii. p. 462.)

The directions of Mr. Middlemore for tracing the cause of amaurosis deserves notice. The surgeon should first investigate the condition of the eye and the eyelids; he should observe whether the upper lip drooped, whether there was any degree of strabismus, and whether the sympathetic and associated movements of the eyes were unaltered; he should then notice the state of the cornea, its clearness, and its form; the state of the pupil, its size, its figure, its degree of motion, and also the distance of the iris from the cornea, as well as its colour and the general appearance of its texture, and whether it be convex or concave, or preserve its natural place; the state of the humours in reference to their transparency, and particularly notice whether any deep-seated buffy or dusky cloudiness were present, and whether the eyeball were increased in vascularity, or changed in colour, figure, size, or consistence. Mr. Middlemore further recommends the effect of belladonna on the pupil to be noticed; and the eye to be examined under its influence, if any influence at all be produced by it, and in various degrees of light, and in connection with the pupil of the opposite eye. The state of the pupil is to be observed at the moment when the lids of both eyes are suddenly separated, and also when the lids of the sound eye are closed, and those of the diseased one separated. Each pupil is also to be examined separately, so as to ascertain its extent and facility of motion.

Mr. Middlemore advises inquiry to be made into the patient's habits, temperament, disposition, and state of mind; whether any visceral disease be present, and what its nature; whether there be any temporary disorder in the alimentary canal; whether the patient is suffering or has been recently suffering from gout, rheumatism, scrofula, or syphilis; whether he has passed through any severe mercurial treatment; whether he has suffered from apoplexy, epilepsy, paralysis, severe fever, inflammation, or concussion, or other injury of the brain; how long the disease has existed; what remedies have been tried, and what their effect. (See *R. Middlemore on Dis. of the Eye*, vol. ii. p. 255.)

In that species of amaurosis which arises from causes inducing the disease, by means of a preternatural fulness and dilatation of the blood-vessels of the brain, or eye, the indication is to lessen the quantity of blood and general plethora, and determination of blood to the head and organ affected. For this purpose the patient may be bled in the arm, or temporal artery. The evacuation is to be repeated as often as seems necessary, and it will be better to begin with taking away from sixteen to twenty ounces. The efficacy of bleeding, in the cure of particular cases, is strikingly exemplified by numerous well-authenticated observations. Richter informs us of a woman who, on leaving off having children, lost her sight; but recovered it again by being only once bled in the foot. A spontaneous hemorrhage from the nose also cured a young woman, who had been blind for several weeks. (*Anfangsgr. der Wundarzn.* b. iii. p. 442.)

That bleeding is sometimes hurtfully and wrongfully practised in amaurotic cases, is a fact which admits of no doubt. Mr. Travers particularly refers to one description of cases, where the lancet does harm: these are cases of undue determination of blood to the organ, which are especially common after deep-seated chronic inflammation or distress from over-excitement, by which its vessels have lost their tone; an effect decidedly increased by depletion. In one interesting case of this kind, a gradual, but perfect recovery, followed a regulated diet, and a course of the blue pill, with saline aperients. (*Synopsis*, p. 159.) All cases of direct debility and proper paralysis of the retina (says Mr. Travers) are aggravated by loss of blood, and the great prevailing mistake in the treatment of amaurosis, is the indiscriminate detraction of blood. (*Synopsis*, p. 303.)

When, in addition to general bleeding, topical is also necessary, leeches may be applied to the temples, or cupping glasses to the back of the neck, or temples. Besides bleeding, purgatives, blisters, bathing the feet in warm water, low diet, repose of the organs, &c. are proper.

In some cases, the foregoing means fail in producing the desired benefit, even when followed up, as far as the pulse and strength will allow. Here the continuance of the disease may depend, either upon the stoppage of some wonted evacuation of blood, or else upon some other cause of the first class. In the first of these cases (says Richter), experience proves thae the disease will sometimes not give way before the accustomed discharge is re-established. A woman, who (as this author acquaints us) had lost her sight, in consequence of a sudden suppression of the menses, did not recover it again till three months after the return of the menstrual discharge, notwithstanding the trial of every sort of evacuation. He also tells us of another woman, who had been blind half a year, and did not menstruate, and to whose external parts of generation leeches were several times applied. As often as the leeches were put on (says Richter), the menses in part recommenced; and, as long as they made their appearance, which was seldom above two hours, the woman always enjoyed a degree of vision. (*Anfangsgr. der Wundarzn.* b. iii. p. 443.)

For the amaurosis arising from suppression of the menses, Scarpa recommends leeches to the pudenda, bathing the feet in warm water, and afterwards exhibiting an emetic, and laxative pills, made of rhubarb and tartrate of antimony, combined with gummy and saponaceous substances. If these means fail in establishing the menstrual discharge, he says great confidence may be placed in a stream of electricity, conducted from the loins across the pelvis, in every direction, and thence repeatedly to the thighs and feet.

For the amaurosis proceeding from the stoppage of habitual bleeding from piles, Scarpa recommends leeches and fomentations to the hemorrhoidal veins, then an emetic, and afterwards the same opening pills. (*Osservazioni sulle principali Malattie degli Occhi*, cap. 19.)

When the disease does not originate from the stoppage of any natural or habitual discharge of blood, and does not yield to the evacuating plan, Richter thinks the surgeon justified in concluding that the preternaturally dilated vessels have not regained their proper tone and diameter, and that topical corroborant remedies, particularly cold water, ought to be employed. In this kind of case, he is an advocate for washing and bathing the whole head with cold water, especially the part about the eyes: a method, he says, which may often be practised, after evacuations, with singular and remarkable efficacy.

The principle on which Mr. Lawrence directs the treatment, is that of putting a stop to vascular excitement, with the view of preventing the permanent injury of altered structure and impaired function of the retina. Hence he is a zealous advocate for the antiphlogistic treatment in the early stage of amaurosis. "But," says he, "if this treatment be not found to remove the change which has been produced in the retina, we must have recourse to mercury, which appears to be as decidedly beneficial in these cases, as in iritis, or general internal inflammation. The remark which I made respecting the use of mercury in those affections, applies also to the present case, namely, that its good effect mainly depends upon the promptitude with which it is employed. The alterative form is insufficient; we give it with the view of arresting inflammation in the structure, which is the very seat of vision; that structure is easily changed by the inflammatory process; our only remedy is to push the mercury in a decided manner, and if we do so, we shall put a stop to the affection." When the amaurotic affection depends on vascular plenitude of the retina, and that peculiar action of its capillary system of vessels which is disposed to bring on organic changes, Mr. Middlemore is also an advocate for mercury, which, for the purpose of stopping such action, and producing an absorption of effused or deposited matter, he directs to be employed freely, so as to affect the mouth. But, he observes, if the amaurotic symptoms are not at all relieved, when the gums have become sore, its use is not to be continued: on the contrary, if any improvement occur, the constitution should be kept under the influence of mercury by the administration of two grains of the submuriate with a small quantity of opium, once or twice a day. (*R. Middlemore on Dis. of the Eye*, vol. ii. p. 277.) Instead of discontinuing mercury, if no amendment take place directly the gums are sore, he advises the patient to be kept at least two or three weeks well under the influence of the medicine; for, unless this be done, it has not had a fair trial. When the antiphlogistic treatment, and a fair trial of mercury have failed, Mr. Lawrence contents himself with recommending such management as is most conducive to general health; as a residence and frequent exercise in a pure air; plain nutritious diet; mild aperients, with the occasional use of an active purgative; and repose of the affected organ. He mentions also a trial of a seton, or repeated blisters behind the ears, or at the side or back of the neck. As already stated, however, he does not wish it to be supposed, that all amaurotic patients require to be bled and salivated. Amaurosis, he says, often comes on in a slow and very insidious manner in persons of enfeebled constitution: the organ suffers from habitual excessive exertion at the same time that the general powers are depressed by residence in confined dwellings, bad air, sedentary occupations, unwholesome diet, costiveness, and the other injurious influences of such causes. If we should see a thin, pallid, and feeble woman, who had destroyed her health by close confinement to needle-work, and whose eyes were beginning to fail, the same active measures would by no means be admissible. We should empty the alimentary canal, perhaps take a little blood by cupping, or by leeches to the temples, and then use mercury in the alterative form, together with mild aperients. A few grains of Plummer's pill may be given every night, or every second night, and the bowels may be kept open with electuary, castor oil, or rhubarb and magnesia, taken occasionally. The blue pill may be taken in combination with aloes or colocynth. It may be necessary, says Mr. Lawrence, to persevere with the mercury, slowly increasing the dose until a slight influence is visible in the mouth. A nutritious but temperate diet, good air and exercise, and repose of the affected organ, are important auxiliaries, and a succession of moderate-sized blisters may be advantageously combined with these means. Thus, observes Mr. Lawrence, the same principles regulate our treatment; but it is modified in degree, according to the violence of the symptoms, and the patient's strength. In the latter description of cases, after mild antiphlogistic means, and clearing the alimentary canal, he admits that it may be expedient to combine tonics with aperients, or rhubarb with bark, calumba, or cascarilla; and to allow a little porter and wine.

We come now to the consideration of that species of amaurosis which is regarded as the effect of some unnatural irritation. Here, according to the precepts delivered by Richter, we should endeavour to discover what the particular irritation is, and then endeavour to effect its removal. Sometimes the irritation is both discoverable and removable, and still the blindness continues. In this circumstance, Richter thinks that the surgeon should endeavour to obviate the impression which the irritation has left upon the nerves, by the use of anodynes; or else try to remove the torpor of the nerves by stimulants. Now, according to Schmucker, Richter, and Scarpa, curable imperfect amaurosis commonly depends on some disease, or irritation in the gastric system, complicated with general nervous debility, in which the eyes participate. Hence it appears to them that the chief indications are, to free the alimentary canal from all irritating matter, improve the state of the chylopoietic viscera, and invigorate the nervous system in general, and the nerves of the eye in particular.

For an adult, Scarpa directs three grains of antimonium tartarizatum to be dissolved in four ounces of water, and a spoonful of this solution to be given every half hour, until nausea and copious vomiting are produced. The next day some opening powders are exhibited, consisting of an ounce of the supertartate of potash, and one grain of antimonium tartarizatum, divided into six equal parts. The patient takes one of these in the morning, another four hours afterwards, and a third in the evening, for eight or ten days in succession. They create a little nausea, rather more evacuations from the bowels than usual, and perhaps, in the course of a few days, vomiting. If the patient, during their use, should make vain efforts to vomit, complain of bitterness in his mouth, loss of appetite, and no renovation of sight, the emetic, as at first directed, is to be prescribed again. This is to be repeated a third and fourth time, should the morbid state of the gastric system, the bitter taste in the mouth, the tension of the hypochondria, the acid eructations, and the inclination to vomit, make it necessary. The first emetic often produces only an evacuation of an aqueous fluid, blended with a little mucus; but, if it be repeated a few days after the resolvent powders have been administered, it then occasions a discharge of a considerable quantity of a yellow, greenish matter, to the infinite relief of the stomach, head, and eyes.

The stomach having been emptied, the following aperient pills are ordered.

℞ Gum. Sagapen. }
Galban. } an. ʒ j.
Sap. Venet. }
Rhei optim. ʒ iss.
Tart. Emet. gr. xvj.
Suc. Liquerit. ʒ j. Fiant pilulæ gran. quinque.

Three are to be taken every morning and evening for a month or six weeks.

When the state of the stomach has been improved, and the restoration of sight partly effected, such remedies must be employed as strengthen the digestive organs, and excite the vigour of the nervous system in general, and of the nerves of the eye in particular. With this intention, Scarpa prescribes bark and valerian in powder, and recommends a diet of tender succulent meat, and wholesome broths, with a moderate quantity of wine, and proper exercise in a salubrious air. For exciting the action of the nerves of the eye, the vapour of liquor ammoniæ, properly directed against the eye, he says, is of the greatest service. This remedy is applied by holding a small vessel, containing it, sufficiently near the eye to make this organ feel a smarting, occasioned by the very penetrating vapours with which it is enveloped, and which cause a copious secretion of tears, and a redness, in less than half an hour after the beginning of the application. It is now proper to stop, and repeat the application three or four hours afterwards.

The operation of these vapours may be promoted by other external stimulants, applied to such other parts of the body as have a great deal of sympathy with the eyes. Of this kind are blisters to the nape of the neck; friction on the eyebrow with the anodyne liquor; the irritation of the nerves of the nostrils by sternutative powders, like that composed of two grains of turbeth mineral, and a scruple of powdered betony leaves; and, lastly, electricity. The external use of strychnia would here deserve trial in the manner presently specified.

The imperfect amaurosis, suddenly brought on in consequence of the body being excessively heated, or of exposure to the sun, or by violent anger, in plethoric subjects, requires general and topical evacuations of blood, and the application of cold washes to the eyes and whole head. Scarpa then prescribes an emetic, and afterwards antimonial purgatives. By means of bleeding and an emetic, Schmucker often restored the eyesight of soldiers, who had lost it in making forced marches. In amaurosis suddenly occasioned by violent anger, an emetic is the more strongly insisted upon after bleeding, as the blindness thus arising is always attended with a bitter taste in the mouth, tension of the hypochondria, and continual nausea. Richter mentions a clergyman, who became completely blind, after being in a violent passion, and whose eyesight was restored the very next day, by means of an emetic, given with the view of relieving some obvious marks of bilious disorder.

Scarpa's treatment of imperfect amaurosis brought on by fevers, deep sorrow, great loss of blood, intense study, and forced exertions of the eyes on very minute or brilliant objects, consists also in removing all irritation from the stomach, and afterwards strengthening the nervous system in general, and the nerves of the eye in particular. In the case originating from fevers, the emetic and opening pills are given; then bark, steel medicines, and bitters; while the vapour of the liquor ammoniæ is applied to the eye itself.

When the disorder has been brought on by grief, or fright, the stomach and intestines are emptied by means of antimonium tartarizatum and the opening pills; and the cure is completed by giving bark and valerian; applying the vapour of liquor ammoniæ to the eyes; ordering nourishing, easily digestible food; diverting the patient's mind, and fixing it on agreeable objects, and recommending moderate exercise. The amaurosis from fright is said to require a longer perseverance in such treatment, than the case from sorrow. (*Scarpa's Osservaz.* cap. 19.)

In this country, this free use of tartarized antimony, which has proved so efficacious on the Continent, has not been found to answer. Mr. Travers states, that he does not recollect an instance of decided benefit from it, though he has often tried it fairly. He agrees, however, in the indication, as he remarks, that the removal of an irritating, or oppressing cause, will often effect a sudden and marked relief, as by clearing the intestinal canal of vitiated secretions, restoring the digestive functions, or taking away blood where the necessity is indicated. In gastric cases, for which emetics have been particularly recommended, he prefers a long-continued course of the blue pill, with gentle saline purgatives, and tonic bitters. (*Synopsis*, p. 299—304.)

Beer is another high authority against the use of emetics, even in the amaurosis from disorder of the gastric organs. Emetics, which never operate without some violence, he says, are to be most carefully avoided in plethoric individuals, or those who have a manifest determination of blood to their heads and eyes, or any acceleration of the circulation. The caution here given must be observed, even though emetics may on other accounts seem advisable; and, according to Beer, the determination of blood and the state of the system here mentioned, are commonly attendant upon this species of amaurosis.

Indeed (notwithstanding the testimony of Schmucker, Richter, and Scarpa, in favour of emetics), Beer positively affirms that the violent operation of an emetic frequently converts this sympathetic amaurotic weakness of sight into complete blindness. Although I apprehend that Beer may here be somewhat prejudiced against emetics, candour obliges me to add, that, in this country, their efficacy in the present disease is by no means equal to the representations of Richter and Scarpa. When there is less tendency to vomiting, but the case is attended with an oppressive sense of weight about the stomach, frequent eructations, as if arising from rotten eggs, an inflated belly, tense hypochondria, and confined bowels, Beer found that clysters and tolerably brisk purgatives were always of the greatest service, both in regard to the general complaints, and the amaurotic weakness of sight; the removal of the offensive matter from the alimentary canal being immediately followed by a cessation of the determination of blood already mentioned. Lastly, when this amaurosis originates altogether from the presence of worms in the bowels, common anthelmintics are to be prescribed. In all these cases, says Beer, mere local treatment is quite inapplicable, and may do mischief. (*Beer, Lehre von den Augenkr.* b. ii. p. 517—521.)

The third species of gutta serena, or that which arises from debilitating causes, is of two kinds; in one, the disease is the consequence of a general weakness of the body; in the other, it is the effect of debility, or atony confined to the retina.

Scarpa regards the *incomplete amaurosis from general nervous debility, copious hemorrhage, convulsions, and long-continued intense study, especially by candlelight*, less as a case of real amaurosis, than a weakness of sight from a fatigued state of the nerves, especially of those constituting the immediate organ of sight. When this complaint is recent, in a young subject, he is an advocate for emptying the alimentary canal with small repeated doses of rhubarb, and then giving tonic cordial remedies. At the same time, the patient is to abstain from every thing that has a tendency to weaken the nervous system, and, consequently, the eyesight. After emptying the stomach and bowels, it is proper to prescribe the decoction of bark with valerian, or the infusion of quassia with the addition of a few drops of sulphuric æther, to each dose, with nourishing, easily digestible food. The aromatic spirituous vapours (mentioned in the article *Ophthalmy*) may then be topically applied; or, if these prove ineffectual, the vapour of liquor ammoniæ. The patient must take exercise on foot, horseback, or in a carriage, in a wholesome dry air, in warm weather, and avail himself of sea-bathing. He must avoid all thoughts of care, and refrain from fixing his eyes on minute shining objects. The impression of vivid light on the retina is to be moderated by means of flat green glasses. (*Saggio di Osservaz.* cap. 19.)

One case of temporary palsy of the retina from over-excitement, mentioned by Mr. Travers, yielded to blistering the forehead, and a gentle salivation excited by calomel joined with opium. (*Synopsis*, p. 164.) Another case, brought on by the use of telescopes and sextants, gave way to a copious bleeding, brisk purging with jalap and calomel, blisters to the temples, and a course of mercury. (*Op.* cit. p. 166.)

Mr. Travers remarks, that the amaurosis from depletion is sometimes mistaken for the opposite case, viz. that from plethoric congestion: this is owing to the coincidence of a dilated and immoveable pupil, muscæ, and a deep-seated pain in the head, with occasional vertigo, and its frequent occurrence in a corpulent habit. By a cautious use of tonics (says Mr. Travers) it is relieved; by whatever lowers, or stimulates, whether diet or medicine, it is decidedly aggravated. In this form of amaurosis, vision is further enfeebled by the loss of as much blood as flows from two or three leechbites. (*Synopsis, &c.* p. 160.)

When the weakness is confined to the eye, Richter thinks corroborant applications alone necessary. Bathing the eye with cold water, says he, is one of the most powerful means of strengthening the eye. The patient should dip in cold water a compress, doubled into eight folds, and sufficiently large to cover the whole face and forehead, and this he should keep applied, as long as it continues cold. Or else he should frequently apply cold water to his eyes and face with his hand, on a piece of rag.

The eye may also be strengthened by repeatedly applying blisters of a semi-lunar shape above the eyebrows, just long enough to excite redness. Richter likewise speaks favourably of rubbing the upper eyelid, several times a day, with a mixture of the tinctura lyttæ and spiritus serpilli. (*Anfansgr. der Wundarz.* b. iii. p. 452.)

Here the endermic application of strychnia deserves to be remembered.

In the *amaurosis suddenly formed by exposure to vivid light or lightning*, we may clear out the alimentary canal with an active dose of calomel and jalap. Blisters may then be applied above the eyebrows; and if these fail, electricity, or the external use of strychnia, may be tried. (See *Middlemore on Dis. of the Eye*, vol ii.) In such cases, Magendie would probably rub an ammoniated ointment over the frontal nerve.

In *amaurosis from the gradual effect of any exposure of the eye to vivid light, or of hard study by light of lamps or candles*, the foregoing treatment would, I think, be less likely to answer. Here a slow inflammation of the retina has probably been going on, followed by structural changes, the only chance of removing which must depend upon depletion, mercury, and perfect rest of the organ. (See *Mackenzie on Dis. of the Eye*, p. 928.)

In *periodical amaurosis*, attended with serious impairment or loss of vision, returning daily, weekly, or monthly, or at irregular intervals, the eye being little or not at all affected in the intermediate periods, the best means of cure are bleeding, purgatives, and counter irritation. This treatment is especially applicable to hemeralopia.

In *amaurosis excited by dentition*, the gums may be divided, mild laxatives and small doses of syrup of poppies given, and the child put into a warm bath. If amaurosis depend upon the irritation of a carious tooth, this should be extracted.

For *amaurosis from a partial wound, or laceration of the supra-orbital nerve*, the best plan is to make a free division of it.

Of late, strychnia has been employed as a remedy for amaurosis. It seems to Mr. Middlemore that its use should be confined to cases, in which the retina is in a state of atony from some cause acting *directly* upon its texture, or upon its texture through the medium of the general debility of the system. At all events, he is of opinion, that it should not be resorted to when there is much vascular fulness either of the system, or the retina, or a tendency to inflammation. Its effects are likewise to be most carefully watched. An atonic state of the retina, or of some part of the nervous apparatus of the eye, productive of amaurosis, when unconnected with a full plethoric habit of body, determination of blood to the head, or any tendency to apoplexy, or any structural change either in the retina, or its immediate nervous relations, may be treated by means of strychnia, particularly if tonics and general stimulants have been already unsuccessfully tried. The bowels are to be first freely opened, and aperient medicine occasionally given during the use of strychnia. Mr. Middlemore puts a narrow blister above the eyebrow of the affected eye, or above each eyebrow, if both eyes are involved; and after the cuticle and serum have been removed, sprinkles a small quantity of strychnia upon the raw surface, commencing with the fourth of a grain upon each side. If vision be not improved, this quantity may be gradually increased to two grains; the part is also dressed with savine cerate. The strychnia is applied only once in twenty-four hours, and the eyebrow is preferred as the place for its action, on account of the probable special effect of the strychnia upon the supra-orbitary nerve, in addition to its other more general influence. If strychnia excite great local uneasiness, it may be blended with a little flour, or powdered opium. Mr. Middlemore observes, that if the patient should become sensible of occasional flashes of light before the eye, soon after the commencement of this treatment, there would be great encouragement to persevere; but that if vision should be not at all influenced, or improved, after the strychnia had been tried a fortnight in sufficiently powerful but not imprudent quantities, it ought to be discontinued. Strychnia appears to him to be well adapted to the case of miners, whose eyes are affected with incomplete amaurosis, and who have been accustomed to follow their employment by means of a very feeble light; and also to cases of impaired sensibility of the retina, occasioned by too great a delay in curing congenital cataract. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 282.)

Strychnia has also been prescribed as an internal remedy for amaurosis.

Cat-eye amaurosis is a case particularly described by Beer; it rarely advances to complete blindness, and occurs chiefly in very old persons. Sometimes, however, it takes place in young subjects, and even in children. Beer alleges that it is always confined either to thin, dwindled, old, gray-headed subjects, in whom the exchange of organic matter is carried on but tardily, or else to young subjects, who are unhealthy, and disposed to consumption, hectical adults, emaciated children, and as a consequence of severe injuries of the eye. While this amaurosis is not perfectly formed, the iris retains its mobility, and the pupil is neither preternaturally dilated nor contracted; but, when once the patient is quite bereft of vision, the motions of the iris are slow, and the pupil larger than in a healthy eye in an equal degree of light. At the bottom of the eye, far behind the pupil, a concave pale gray, bright yellowish, or variegated reddish opacity, is developed. By this the eyesight is not merely weakened, but rendered quite confused, since all objects, and especially smallish ones, appear to be confounded together, particularly when the patient tries to inspect closely any determinate body. The further the disease advances, the brighter and more visible is the bottom of the eye, the paler is the colour of the iris (a thing very conspicuous in dark-eyed persons); and when once the amaurosis is complete, so that no susceptibility of the impression of light is left, then, upon an attentive examination of the eye, one can mostly perceive, at the troubled deeper part of the eye, a slender vascular plexus, which merely consists of the ordinary ramifications of the central artery and vein. In a half-darkened place, such an eye presents a shining yellowish or reddish appearance, but only in certain positions of the eyeball; and, in this respect, it is somewhat similar to the eye of a cat, whence Beer chooses to term the complaint cat-eye amaurosis. The disorder is also not accompanied with any other essential morbid appearances, except the decline of vision, or complete blindness. (*Lehre von den Augenkr.* b. ii. p. 496.) Beer, in fig. 1. tab. 4. of his second vol. has given, from nature, an admirable representation of this remarkable species of amaurosis. The differences in the appearances at the bottom of the eye, in this case, from those presented in the early stage of fungus hæmatodes of that organ, will be best understood by referring to the article *Fungus Hæmatodes.* On this point, however, I may here briefly state, that, in cat-eye amaurosis, there is *no projection,* but, on the contrary, *a concave depression* in the axis of vision. Cat-eye amaurosis may be known from incipient cataract, by the opacity being more deeply situated, and having a shining pearly lustre. (See *Journ. of Foreign Med.* vol. iv. p. 168.)

Beer observes, that the causes of this species of amaurosis are so obscure, that whatever is offered upon the subject can be received only as conjecture. A suspicion is sometimes entertained, that a deficiency of the pigmentum nigrum, and of the tapetum of the uvea, is concerned in the production of this form of blindness.

The prognosis cannot but be very unfavourable; for, as the surgeon is ignorant of causes, he cannot know what means ought to be adopted for their removal. It is fortunate, however, that this amaurosis rarely attains its highest degree, but almost constantly remains in the form of a more or less considerable amblyopia.

Just as little is yet known respecting any well-regulated mode of treatment; but the disease may sometimes be kept from getting worse, by the careful employment of such general remedies, regimen, and diet, as are calculated to improve the health. However, in the most fortunately managed cases, Beer never knew a step made towards the removal of the disease. (*Lehre von den Augenkr.* b. ii. p. 497, 498.)

An *amaurosis* is described as produced by certain vegetable *bitters,* by lead, and by particular articles of food. But the reality of such cases is doubted by Mr. Lawrence. (*Op.* cit. p. 491.)

Symptomatic amaurosis in individuals affected with hysteria, hypochondriasis, epilepsy, and convulsions, is rarely permanent, and usually subsides as soon as the spasmodic, epileptic, or convulsive attack is over. However, the complaint may begin at two periods, viz. either during such an attack, or (what is more uncommon) afterwards, and it never loses its symptomatic character. The pupil, which is much dilated, always remains perfectly clear, and of a shining blackness, even when the disease has induced entire blindness; but a slight dull pain in the forehead, especially about the eyebrow, constantly preceding and accompanying the blindness, generally lasts a good while after the amaurosis has completely subsided.

As this amaurosis is merely a symptomatic effect of the above general disorders, its removal must entirely depend upon the success with which their treatment is conducted. (*Beer, Lehre von den Augenkr.* b. ii. p. 506—510.)

With respect to *rheumatic amaurosis,* we do not in this country recognise any distinct form of amaurosis entitled to the name of rheumatic, though Beer has minutely described such a case. No doubt a certain proportion of amaurotic patients suffer from rheumatism; but I agree with those pathologists, who do not acknowledge rheumatism as having been clearly proved to be a cause of amaurosis.

Gouty amaurosis.—According to Mr. Travers, gout attacks the eye through the medium of the stomach. Vomiting occurs, with pain in that organ, on the subsidence of an inflammation in the extremities, and is succeeded by violent pain in the head. The loss of sight, he adds, is sudden and permanent. (*Synopsis, &c.* p. 163.) The gouty amaurosis, described by Beer, is perhaps badly named: at all events, there are some circumstances in its history, which must create doubts about its dependence upon gout. "We can admit," says Mr. Lawrence, "that the nervous structure of the eye may be diseased in the rheumatic and gouty, as well as in other persons; but it will require clearer evidence than we possess at present to show, that there are distinct gouty and rheumatic amauroses." (*Lawrence, Op.* cit. p. 491.) When we find Beer describing one form of gouty amaurosis as taking place only in dark-eyed slender maiden ladies, who have suffered from scrofula in their childhood, or from other severe diseases at a later period, and whose menses are irregular, or have ceased, we must regard his evidences of gouty amaurosis as vague and fanciful.

When amaurosis follows the healing of old sores, Beer recommends the formation of them again, by applying to the cicatrix strong mustard ataplasms, and the muriate of soda; and, if the new ulcers cannot be made to discharge properly, he recommends issues on the legs or thighs. These plans are to be aided by such medicines as act specifically upon the skin, like antimonials, especially the sulphur auratum antimonii. Beer also speaks favourably of sulphur baths; and, in cases complicated with debility, administers tonics. (See *Lehre von den Augenkr.* b. ii. p. 556—563.) When *amaurosis has followed the sudden healing of ulcers,* or the *disappearance of an eruption,* or the suppression of some customary evacuation, Mr. Middlemore is an advocate for counter irritation by means of a seton or issue. (*On Dis. of the Eye,* vol. ii. p. 279.)

When *amaurosis proceeds from disease of the optic nerves, or their sheaths,* it comes on slowly, and rarely attacks both eyes together. It commences with a black cloud, which grows more and more dense, and with a troublesome, alarming perversion and disfigurement of every object, without the least painful sensation in the eye or head. The patient merely complains of a slight sensation of dull pressure at the bottom of the orbit, as if the eyeball were about to be forced from its socket, of which displacement, however, there is not yet the smallest appearance. In the very beginning of the disease, the pupil is already considerably dilated, and the pupillary edge of the motionless iris presents angles at several points, the pupil sometimes representing an irregular pentagon, or hexagon. By degrees, though very slowly, a glaucomatous change of the vitreous humour ensues, and afterwards of the lens itself; the only species of glaucoma which Beer has ever noticed quite unattended with a varicose affection of the blood-vessels of the eye. At last, the globe of the eye becomes perceptibly smaller than natural; but a complete atrophy does not ensue.

When *amaurosis proceeds from disease of the skull or brain,* it usually attacks both eyes together, or at least one soon after the other, the blindness also commencing very slowly, with appearances as if every object looked at were perverted or disfigured. However, there is no black cloud, but rather an obscurity or confusion of every object. The disease in this stage is also accompanied with frequent giddiness, ugly luminous spectra, and, for the most part, with aversion to light, uncommonly lively motions of the iris, a contracted pupil, angles in the upper and lower portions of the pupillary margin of the iris; an evident turgescence of the blood-vessels of the eye, gradually augmenting with most violent headach into actual cirsophthalmia; frequent convulsive motions of the eyes and eyelids, and strabismus of one or both eyes, ending in a true deviation of one or both these organs from their natural positions. Under these symptoms, vision is afterwards entirely abolished; and the headach, though subject to remissions, grows so much worse, extending back to the spine, that the patient is often nearly frantic, and, indeed, after a time, a destruction of the external senses happens, followed by that of the intellectual faculties. The first of the external senses which is lost is always the hearing, which infirmity is next followed by loss of the smell, or taste, or both these senses together; and then the memory, and other intellectual powers decline. In this stage of the disorder, the eyeball not unfrequently protrudes from the orbit; a pathognomonic symptom, to which Beer attaches great importance, because it is an infallible criterion of a diseased state of the bones of the orbit, of the parts which invest this cavity, and of the optic nerve and dura mater, in the sella turcica. In such cases, complete mania now usually follows, and this sometimes in its most violent form, unless the patient happen to be first carried off by paralytic symptoms; life, under these circumstances, never lasting any considerable time.

The cause of both these forms of amaurosis lies in certain morbid changes in the structure of the optic nerve and its investments, or in diseased alterations of the bones of the cranium, the dura mater, and the brain. But, how these changes arise, is not so easy of explanation. The morbid changes in the structure above mentioned, which Beer had himself ascertained by dissection, consist in a real induration of the optic nerves, and an adhesion of them to their sheaths, while within the skull these ash-coloured, gray, very much diminished nerves, presented no vestige of medullary structure even as far as their origin from the brain. On the contrary, the optic thalamus presented externally its natural appearance. The retina seemed to have lost its pulpy matter, was tough, not easily torn, and appeared to consist but of a vascular membrane. In one example, although both eyes had been completely deprived of sight together, Beer found only the retina and optic nerve of the left side in this state of atrophy as far forwards as the point of union in the sella turcica. On the other hand, the optic nerve of the right eye was hard, without being in the least dwindled, and was closely adherent to its external coverings. Anteriorly to their decussation, nothing at all preternatural in either nerve could be discerned. But the left corpus striatum was so indurated, that a very sharp, strong scalpel was required for its division, though in colour and shape it was perfectly natural. On this side, also, the plexus choroides was entirely wanting. In three amaurotic patients of this kind, Beer found hydatids between the coverings of the optic nerve; and where such hydatids lay, the medullary matter seemed to have been displaced by their pressure. With the utmost care, he could not trace the ophthalmic ganglion.

Raw also found on the optic nerve a large hydatid, which had produced amaurosis. (*Obs. Anat. Rarior.* Obs. 2.) In Mr. Heaviside's museum, there was a preparation of the optic nerve of an amaurotic eye, where a tumour of considerable bulk had grown from the neurilema. (See *Wardrop's Essays on the Morbid Anatomy of the Human Eye*, vol. ii. p. 157.) In this work are specified examples of various other morbid changes of the optic nerve, especially calculous concretions within it, the presence of a viscid, muddy, gray fluid, in the thickened neurilema, instead of pulp, atrophy of the nerve, &c.

To the present description of cases, Beer refers the instance recorded by Haller (*Opusc. Pathol.* Obs. 65. p. 172.) in which a calcareous mass was found betwixt the membrane of Ruysch and the vitreous humour. According to Beer, there is preserved in the pathological and anatomical museum of the general hospital at Vienna, an eye, distended with a similar osseous mass, without the capsule of the lens being at all affected. Examples, in which the amaurotic blindness arose from abscesses in the brain, are reported by Ballonius (*Paradigmata Hist.* 7.), by Pelargus (*Med. Jahrg.* b. iii. p. 198.), Peyronie (*Mém. de l'Acad. Royale de Chir.* t. i. p. 212.), Schaarschmid (*Berlin Nachrichte*, 1740, No. 26.), Langenbeck (*Neue Bibl.* b. i. p. 61.), and Mr. Travers (*Synopsis*, p. 143.). The latter author has recorded an instance in which a firm lardaceous tumour, of the size of a garden bean, situated on the same side as the blindness, compressed the optic ganglion and nerve at its origin from it. (*Synopsis*, p. 151.) I have seen a case of amaurosis, in which a medullary tumour as large as a middling-sized apple was found in the anterior lobe of the brain, attended with protrusion of the eye, and vast destruction of the bones. I was consulted in 1835, for a case of amaurosis in a young lady, 14 years of age, the daughter of a surgeon. The pupils were remarkably large, and of a clear black colour. She died suddenly, and a tumour, formed in the anterior lobe of the brain, was found to have been the cause of the blindness, and of her death. Mr. Travers has seen amaurosis produced by a medullary fungus of the brain. A case, occasioned by disease of the thalamus, is related by Villeneuve (*Journ. de Méd. continué*, 1811, Févr. p. 98.); another of a tumour of the thalamus on the same side as the blindness, is recorded by Ford (*Med. Commun.* vol. i. No. 4.); and other swellings in various parts of the brain are described in *Ephem. Nat. Cur.* Dec. 3. Ann. 9. and 10. Obs. 253.; *De Haen's Ratio Medendi*, P. 6. p. 271.; *Journ. des Savans*, 1697; *Muzell's Wahrnehm.* b. ii. No. 13.; *Plater, Obs.* lib. i. p. 108.; *Thomann, Annalen fur* 1800, p. 400, &c.; *Wardrop's Essays on the Morbid Anatomy of the Human Eye*, vol. ii. p. 174, &c.

The morbid alterations of the bones of the skull mostly happen at its basis; and not only may caries take place, but still more frequently exostoses of various forms, which are sometimes so small that they are first detected by the bone giving the feel of a rough grater. At the same time they are so sharp, that, if the finger be passed rudely over them, it will be painfully hurt. In these cases, the bones of the cavity of the skull are always found extremely thin; the diploe is almost entirely wanting, and the parietes of the orbit are preternaturally diaphanous, and in some places imperfect. Beer speaks of a lady's skull, who had been completely blind, and for some weeks previously to her death insensible, in which instance scarcely any part of the cavity of the skull could be touched without risk of the fingers being hurt by spiculæ. Once in an amaurotic boy, who, for a short time before his death, was so insane, that he used to devour his own excrement, Beer found at the side of the sella turcica a long considerable spicula, which passed directly through the optic nerves at the place of their decussation. A case of amaurosis, produced by a spicula of bone injuring the opposite side of the brain, is related by Anderson. (See *Trans. of the Society of Edinb.* vol. ii.) Sometimes the ethmoid bone has been found carious (*Ballonius, Paradigmata*, No. 7.); sometimes other parts of the cranium. (*Mursinna, Beobacht.* b. i. No. 6.; *Schmucker, Vermischte Schrift.* b. ii. p. 12.) Sometimes the medullary substance of the brain itself is as soft as pap, while the cortical substance is full of blood-vessels, and unusually firm, the convolutions being hardly distinguishable.

Many of the causes of amaurosis are of such a nature as to render the disease totally incurable. Of this description is fungus hæmatodes, in which the structure of the retina and optic nerve is changed in a remarkable manner, the whole cavity of the eyeball becoming filled with a substance resembling medullary matter, and the optic nerve changed in its form, colour, and structure. (See *Wardrop's Essays on the Morbid Anatomy of the Human Eye*, vol. ii. p. 156. 8vo. Lond. 1818.)

On the authority of Ecker, one case is upon record, where the cause of amaurosis depended upon an aneurism of the central artery of the retina. (*Pinel, Nosographie Philos.* t. ii. p. 122.)

In another instance, the macula lutea, which is naturally a yellow spot near the centre of the retina, was found black. (*Mém. de la Société Méd. d'Emulation*, an. 1798.)

Magendie states, that he has seen the retina transformed into a fibrous membrane; though Andral suspects that the change could not have happened in the nervous expansion itself, but rather in the very fine cellular substance between it and the choroid coat. (*Anat. Pathol.* t. i. p. 272.) An osseous capsule also, sometimes produced within the eye, and usually regarded as an ossification of the retina, he offers good reasons for setting down as really an ossification of the cellular tissue between the retina and choroid tunic. (*Op.* et vol. cit. p. 297.)

Bonetus, in his *Sepulchretum Anatomicum*, lib. i. sect. 18., describes various cases which were quite incurable: after death, the blindness in one instance was found to be occasioned by an encysted tumour, weighing fourteen drachms, situated in the substance of the cerebrum, and pressing on the optic nerves near their origin. In the second, the blindness was produced by a cyst, containing water, and lodged on the optic nerves, where they unite. In a third, it arose from a caries of the os frontis, and a consequent alteration in the figure of the optic foramina. In a fourth, the cause of the disease was a malformation of the optic nerves themselves. Mr. Lawrence refers to a specimen in Mr. Langstaff's museum, exhibiting the eyes, optic nerves, and part of the basis of the brain of a man, who had been amaurotic for twenty-eight years. The sclerotica, cornea, iris, pupil, choroid coat, and retina, are perfectly healthy. The optic nerves, in their whole extent, from the globes backwards, are shrunk into white cords, not larger than a small crow-quill. At the point of union, they merely lie together without being joined, and each proceeds to its own side of the brain. Where they sweep round the crura cerebri, they are gradually confused and lost. (See *Lawrence on Dis. of the Eye*, p. 500.) Fractures of the skull at the anterior part of its basis may cause pressure on one, or both optic nerves, or on their union, or may otherwise injure them. (See *Case in Sir B. Brodie's Paper on Inj. of the Brain*, in *Med. Chir. Trans.* vol. xiv.) These nerves may be variously affected by disease of the bone, or its membranous coverings, in the same situation; or, in the orbit, such disease may have a venereal origin, and be indicated by the simultaneous existence of other symptoms referrible to the same cause. (See *Lawrence on Dis. of the Eye*, p. 498. Also *Case by Wilson* in *Trans. of Soc. for Improvement of Med. & Chir. Knowledge*, vol. iii.) In some of the instances, in which no apparent alteration can be discovered in the optic nerve, the late Mr. Ware conjectured that a dilatation of the anterior portion of the circulus arteriosus may be the cause of the affection. The circulus arteriosus is an arterial circle, surrounding the sella turcica, formed by the carotid arteries on each side, branches passing from them to meet each other before, and other branches passing backwards, to meet branches from the basilary artery behind. The anterior part of the circulus arteriosus lies directly over, crosses, and is in contact with, the optic nerves; and just in the same way as the anterior branches lie over the optic nerves, the posterior ones lie over the nervi motores oculorum. Hence Mr. Ware attempted to refer the amaurosis itself, and the paralytic affection of the eyelids, and muscles of the eyes, sometimes attendant on the complaint, to a dilatation of the anterior and posterior branches of the circulus arteriosus. The frequently diseased state of the trunk, or small branches of the carotid arteries at the side of the sella turcica, is noticed by Dr. Baillie in his useful work on Morbid Anatomy, and he says the same sort of diseased structure is also found in the basilary artery and its branches. (See *Ware's Chir Obs. on the Eye.*)

In 1826, M. Magendie related to the French Academy of Sciences various facts exemplifying the remarkable influence of the fifth nerves over all the senses; and, with respect to the sense of sight, he finds that the action of the eyeball and optic nerve cease immediately they are completely deprived of the influence of those nerves. Thus, a state of the eye is produced that has the greatest analogy to amaurosis. Indeed, when the fifth nerves are divided in an animal, it is instantly bereft of sight on the side on which the nerve has been cut, notwithstanding the eye retains at the moment all the physical conditions necessary for vision. It is not to be supposed, however, that the fifth nerves perform the function usually referred to the optic ones. To *perceive the light*, and *to see*, as Magendie remarks, are, experimentally speaking, two different things. An animal, whose fifth nerves have been divided, does not see, neither is it conscious of the daylight, or of the strongest artificial light; yet it decidedly perceives the impression of the rays of the sun, when they fall directly on the eye. Hence, a healthy, sound condition of the optic nerve, on the one part, and of the fifth nerve on the other, is essential to perfect vision; and M. Magendie therefore deems it highly probable, that there are two kinds of amaurosis; one depending on a particular affection of the optic nerve, and retina; the other on disease of the fifth nerve, and the defect of its influence on the organ of vision. These reflections led him to make trial of a combination of acupuncture and galvanism for the cure of certain cases of amaurosis. Thus, in one case, having introduced one needle into the frontal nerve, and another into the upper maxillary one, he brought the needles into repeated contact with the two poles of a voltaic pile. In a fortnight, the patient had received considerable benefit from the plan. Other facts are also recorded in favour of this treatment. (See *Journ. Expér. de Physiol.* t. vi. p. 156. *et seq.*)

Trnka de Krzowitz, Historia Amauroseos, 8vo. Vindob. 1781. *W. Hey*, in Practical Obs. in Surgery, and Med. Obs. and Inquiries, vol. v. *Schmucker's* Wahrnehmungen, b. i. p. 273. *Richter's* Anfangsgründe der Wundarzneykunst, b. iii. *De Wenzel*, Manuel de l'Oculiste, ou Dictionnaire Ophthalmologique, 8vo. Paris, 1808. Vermischte Chirurgische Schriften von *J. L. Schmucher*, b. ii. Berlin ed. 2. 1786. *D. G. Kieser*, Ueber die Natur, Ursachen, Kennzeichen und Heilung des schwarze Staars, 8vo. Gott. 1811. *Langenbeck*, Neue Bibl. für die Chirurgie. b. i. Hanover, 1815. *J. Beer*, Lehre von den Augenkrankheiten, b. ii. 8vo. Wien, 1817. *James Wardrop*, Essays on the Morbid Anatomy of the Human Eye, vol. ii. 8vo. Lond. 1818. Remarks on Ophthalmy, &c. by *James Ware*. Inquiry into the Causes preventing Success in the Extraction of the Cataract, &c. by the same. *A. Scarpa*, Osservazioni sulle Malattie degli Occhi Venez. 1802. *Frick* on the Diseases of the Eye, by *Welbank*, 8vo. Lond. ed. 2. 1826. Some scattered remarks in the posthumous work on the Diseases of the Eye of the late *J. C. Saunders*, &c. *J. Stevenson*, on the Nature, &c. of the different Species of Amaurosis, 8vo. 1821, *B. Travers's* Synopsis of the Diseases of the Eye, &c. 8vo. Lond. 1820. *Lawrence* on Diseases of the Eye, 8vo. Lond. 1833. *Richard Middlemore* on Diseases of the Eye, vol. ii. p. 242, &c. 8vo. Lond. 1835. *Wm. Mackenzie* on Diseases of the Eye, p. 897. 8vo. Lond. 1835. Dr. *Jacob*, in Cyclop. of Pract. Med. part i. *Fosbroke's* Treatment of Deafness and Amaurosis by Strychnia applied to a blistered Surface behind the Ear, Lancet, 1834-35, vol. i. p. 917. *R. Liston*, on the same subject, in Med. Gazette, vol. v. p. 541. and 575. He blistered the temples, and began with a quarter of a grain

of strychnia on each side, gradually increasing the quantity to one grain and a half, which brought on headach, vertigo, debility, nausea, and tremblings. See also articles *Cataract*, *Diplopia*, *Fungus Hæmatodes*, *Hemeralopia*, *Hemiopia*, *Nyctalopia*, *Sight*, *Defects of*, *&c.*

AMBE (from ἄμϐη, the projecting edge of a rock). An old chirurgical machine for reducing dislocations of the shoulder, and so called because its extremity projected like the prominence of a rock. Its invention is referred to Hippocrates. The ambe is the most ancient mechanical contrivance for the above purpose; but it is not at present employed. Indeed, it is scarcely to be met with in the richest cabinets of surgical apparatus. It is composed of a piece of wood, rising vertically from a pedestal. With the vertical piece is articulated, after the manner of a hinge, a horizontal piece, with a gutter formed in it, in which the luxated limb is laid and secured with straps. The patient places himself on one side of the machine; his arm is extended in the gutter, and secured; the angle, formed by the union of the ascending piece, and by the horizontal branch, is lodged in the armpit, and then the horizontal branch is depressed. In this way extension is made, whilst the vertical part makes counter-extension, and its superior part tends to force the head of the humerus into the articular cavity. But there is nothing to fix the scapula, and the compression made by the superior portion of the vertical piece of the machine tends to force the head of the humerus into the glenoid cavity, before it is well disengaged by the extension.

AMBLYOPIA (from ἀμϐλὺς, dull, and ὤψ, the eye). Hippocrates means by this word, in his Aph. 31. Sect. 3., the dimness of sight to which old people are subject. Modern writers generally understand by amblyopia incomplete amaurosis, or the weakness of sight attending certain stages and forms of this disorder.

AMMONIÆ MURIAS, AMMONIA MURIATA. *Sal Ammoniac.* Its chief use in surgery is as an external discutient application. (See *Lotio Ammon. Muriatæ cum Aceto.*)

Mr. Justamond recommends the following application to milk-abscesses: ℞ Ammoniæ Muriatis ℥j. Spiritus Roris marini lb.j. Misce. Linen rags, wetted with the lotion, are continually applied to the part affected. There can be little doubt of the utility of this lotion in dispersing the induration left after mammary abscesses; but while these cases are accompanied with much pain, tension, and inflammation, emollient fomentations and poultices are to be preferred. For rubefacient purposes, pure ammonia is extracted from the decomposition of muriate of ammonia by means of the soda contained in soap. A plaster is made by combining ℥j of soap with ʒij of common litharge plaster; and when nearly cold, adding ʒj of muriate of ammonia in fine powder. From this nearly ℈j of ammonia in a pure state is slowly evolved, and exerts its action on the skin. (See *A. T. Thomson's Elem. of Materia Med.* p. 957. ed. 2.)

If muriate of ammonia be mixed with its weight of powdered nitre, and dissolved in six or eight parts of water, it produces a very cold lotion, which may be used, as a substitute for ice, in cases of strangulated hernia.

AMPUTATION. The operation of cutting off a limb, or other part of the body, as the breast, penis, &c.

Such an operation frequently becomes indispensably proper, on the principle of sacrificing a branch, as it were, for the sake of taking the only rational chance of saving the trunk itself. Indeed, the suggestion of this measure, in cases of mortification, where there is no chance of the parts recovering, may be said to be derived from nature herself, who, by a process to which I shall advert in speaking of *mortification*, detaches the dead from the living parts; this separation is followed by cicatrization, and the patient recovers.

The necessity for amputation has always existed, and ever will continue, so long as the destructive effects of injuries and diseases of the limbs cannot be obviated in any other manner. As Graefe observes, there was once a period (I should say, about forty years ago) when the operation was more frequently practised than at present, and this fact is to be imputed less to the caprice of surgeons, than to the imperfection of the means which used to be employed for the relief of local diseases. For then aneurisms of the limbs, and some other cases, at present treated with success, were always deemed incurable without amputation. Boucher, Gervaise, Faure, and Bilguer inveighed against the frequent performance of amputation on the field of battle; yet their arguments must prove of little value, unless a path were at the same time traced, which would conduct us to the method of remedying the circumstances which form the necessity for the operation. When this condition is fulfilled, and more effectual modes of treatment are devised, as, for instance, with respect to the gunshot wounds specified by Bilguer, then the necessity for amputation in such cases would cease of itself. (*Normen für die Ablösung grösserer Gliedmassen*, p. 13. 4to. Berlin, 1812.)

As the author of another valuable modern work has said, it is an excellent observation, founded on the purest humanity, and justified by the soundest professional principles, that to *save one limb is infinitely more honourable to the surgeon, than to* have performed numerous amputations, however successful; but it is a remark, notwithstanding its quaintness, fully as true, that it is much better for a man "to live with three limbs, than to die with four." (*Hennen on Military Surgery*, p. 251. ed. 2.) To this saying should be added the reflection, that some unfortunate beings, influenced by a relish for life, have been known to submit to the loss of all their legs and arms, and yet recover. In the Hôtel des Invalides at Paris, mutilated objects are in recollection, who had lost all their thighs and arms, so that, unless assisted, they could not stir, and it was necessary to feed and wait upon them, like new-born infants. (*Morand. Opusc. de Chir.* p. 183.; and *Graefe, Op.* cit. p. 23.)

The amputation of limbs was anciently practised under many disadvantages. The best way of making the incisions was unknown; the ignorance of the old surgeons about the right method of stopping hemorrhage was the death of a large proportion of the patients who had courage to submit to the operation; the mode of healing the wound by the first intention was not understood, or not duly appreciated; and the instruments employed were as awkward and clumsy, as the dressings were irritating and improper.

Modern practitioners have materially simplified all the chief operations in surgery: an object which has been accomplished, not merely by letting anatomical science be the main guide of their proceedings; not simply by devising more judicious and less painful methods; not only by diminishing the number, and improving the construction, of instruments; but also, in an essential degree, by abandoning the use of a multitude of external applications, most of which were useless or hurtful.

The Greek, Roman, and Arabian practitioners amputated limbs with feelings of alarm, and, in general, with the most melancholy results; while modern surgeons proceed to the operation completely fearless, well knowing that it mostly proves successful: hence, as Graefe justly remarks, nothing can be more evident, than that the patient's safety must depend very much upon the kind of practice. (See *Normen für die Ablösung grösserer Gliedmassen,* p. 1.) By practice is here implied the mode in which the operation is performed, the way in which the wound is dressed, and the whole of the after-treatment.

But much improved as amputation has been, it cannot be dissembled, that it is an operation at once terrible to bear, disagreeable to behold, and sometimes severe and fatal in its consequences, while the patient, if saved, is left for ever afterwards in a crippled, mutilated state. Hence it is the surgeon's duty never to have recourse to so serious a proceeding, without a perfect and well grounded conviction of its necessity. Amputation should be generally regarded as the last expedient to which a surgeon ought to resort; an expedient justifiable, as a late writer says, only when the part is either already gangrenous, or the seat of so much injury, or disease, that the attempt to preserve it any longer would expose the patient's life to the greatest danger. (*Dict. des Sciences Méd.* t. i. p. 472.)

Although this amounts to a confession, that the cure of some local disorders is not within the limits of our art, yet, on the other hand, it furnishes a proof, that surgery may be the means of saving life under circumstances which, without its assistance, would infallibly have a fatal termination. The operation is adopted as the safest measure: the cause is removed for the prevention of consequences. (*Graefe, Op.* cit. p. 14.)

Nothing can be more absurd, or more misapplied, than the censures sometimes passed upon amputation, because the body is mutilated by it, &c. Although the objection proves the limitation of human knowledge and ability, it must be very unfair on this account to throw blame on surgery, or the practitioner who thus saves the patient's life. For, without dwelling upon the fact, that a humane surgeon would never amputate through a mere love of operating, and without urgent cause, one may simply ask, Are all diseases in their nature curable? Does not the surgeon cure such as are curable, without mutilation? And are not cases, which were in the beginning remediable, often first brought to the surgeon when, from neglect, they have become totally incurable? Is it not his duty then to employ the only means left for saving the patient? And is not the preservation of a long and healthy life a compensation for the sacrifice? Would it not be just as reasonable to blame an architect, when the irresistible force of lightning or a bomb destroys his building? Indeed, is it not rather a greater honour to surgery, that, even when death has already taken possession, as it were, of a part, and is threatening inevitable destruction to the whole, a means is yet furnished, not only of saving the patient's life, but of bringing him into a state in which he may recover his former good health? (*Brünninghausen, Erfahrungen und Bemerkungen über die Amputation,* p. 11. 12mo. Bamberg, 1818.)

Though amputation is in every respect much better than in former times, and its right performance is by no means difficult, I would not wish to be thought to say, that it is always or even usually done *secundum artem,* because long opportunities of observation have convinced me of the contrary; and the reason of the knife being yet so badly handled in this part of surgery, may generally be imputed to carelessness, slovenly habits, or, what is as bad, a want of ordinary dexterity. There are several egregious faults in the method of amputating, which even many hospital surgeons in this metropolis are guilty of; but these we shall find, when we criticise them, are for the most part easily avoidable, without any particular share of skill being required. A greater difficulty is to ascertain with precision the cases which demand the operation, those in which it may be dispensed with, and the exact periods at which it should be practised. These are considerations requiring profound attention, and the brightest talents. The most expert operator (as Mr. O'Halloran observes) may not always be the best surgeon. To do justice to the sick and ourselves, we must, in many cases, rather avoid than perform capital operations; and with respect to amputation, if we consider the many cases in which it has been unnecessarily undertaken, or done at unseasonable periods, it may be suspected that this operation, upon the whole, may have done more mischief than good. At all events, it is not enough for a surgeon to know *how* to operate; he must also know *when* to do it. (See *O'Halloran on Gangrene and Sphacelus: Preface.*)

For such reasons, I shall first take a view of some of the circumstances under which the best surgeons deem amputation necessary; though in each of the articles relative to the particular diseases and injuries which ever call for the operation, additional information will be offered. Some of these affect the bones, or joints; others, more especially the soft parts. As a general maxim, it is the rule to amputate, whenever the injury, or disease, of the parts, is such, that either primarily, or consecutively, the limb must be lost, or symptoms induced, putting the patient's life into imminent peril. (See *Dupuytren, Clin. Chir.* t. iv. p. 234.)

1. Compound Fractures.

In a compound fracture, the necessity for amputation is not altogether proportioned to the seriousness of the accident, but frequently depends in part upon other circumstances. For example, in the field, and on board of a crowded ship, it is not constantly in the surgeon's power to pay such attention as the cases demand, nor to procure for the patient the proper degree of rest and good accommodation. In the field, there is often a necessity for transporting the wounded from one place to another. Under these circumstances, it is proper to have immediate recourse to amputation, in numerous cases of bad compound fractures, some of which, perhaps, might not absolutely demand the operation, were the patients so situated as to be capable of receiving all the advantages of the best and most scientific treatment in a well-ventilated quiet house, or hospital, furnished with every desirable convenience. At the same time, daily experience proves, that there are many other cases, in which it would be improper to have recourse to the knife, even under the most unfavourable circumstances of the above description. So, when a compound fracture occurs, in which the soft parts have not been considerably injured; in which the bones have been broken in such a direction that they can be easily set and kept in their proper position; or in which there is only one bone broken; amputation would be unnecessary and cruel. But, when the soft parts have been more extensively hurt, and the bones have been so badly broken, that perfect quietude and incessant care are required to afford any chance of recovery, it is a good general rule to amputate whenever these advantages cannot be obtained.

The bad air in crowded hospitals and large cities,—a circumstance so detrimental to wounds in general,—is another consideration which may seriously lessen the chances of saving a badly broken limb, and should be remembered in weighing the reasons for and against amputation.

On this part of the subject, I find the sentiments of Graefe interesting. "Besides an absolute," says he, "there is a relative, necessity for amputation: it is the most mournful, and proceeds altogether from unfavourable external circumstances, though, alas! in many cases nearly unavoidable, when life is to be preserved. In war, every bloody action furnishes proof of what has been stated. The number of the wounded is immense; the number of surgeons for the duty too limited. The supplies most needed are at a distance. In these emergencies, though the military surgeon may, from routine and genius, be able to suggest the quickest method of obtaining what is wanted, know how to avail himself of every advantage which circumstances permit, and contrive tolerable substitutes for such things as are deficient, yet this will not always do. Were we (says Graefe) here to complain of the government not providing due assistance for the defenders of our native soil, to many the remonstrance would only appear reasonable. Yet, they who manage the medical affairs of the Prussian army may not constantly have it in their power to avert the inconvenience. The general cannot foretell the number and nature of the wounds which may happen, so as to enable the medical department to take with them exactly the apparatus required, without encumbering the army with a redundance of useless articles. The enemy, perhaps, captures the medical stores, or the rapid movements of particular corps cut us off from the principal depôts. Detachments often skirmish at remote points. The hospitals may lie several miles in the rear of the line; and, for want of means, the transport of the imperfectly dressed wounded may continue night and day. Hardly are the sufferers brought into the nearest hospital, in the most pitiful state from pain, anxiety, and cold, when an order is given to break up, and they must be conveyed still further towards their grave: and a thousand other circumstances (as Graefe observes) which deprive the wounded of the requisite attendance, and essential number of surgeons, together with the most necessary stores, make it desirable to simplify every wound as much as possible; which, indeed, is the only means of shunning the reproach, that while we are endeavouring to save one man's limb, we let another die.

"Who doubts (says Graefe) that a soldier with a gunshot wound, complicated with a smashed state of the bones, may sometimes be saved, without loss of his limb, by employing all the means which the resources of surgery offer? But these very resources are often wanting in a campaign; and the business of dressing the patient would occupy the surgeon several hours daily, during which his useful assistance could not be extended to other sufferers. Notwithstanding the utmost care, the removal of patients from one place to another frequently makes their wounds extremely dangerous, or fatal; and we now lose many a man, who, had he undergone amputation, would have been able to bear the journey." (See *Normen für die Ablösung grösserer Gliedmassen*, p. 15, 16.)

From what I have seen of the ill effects of moving patients with bad compound fractures of the lower extremity, produced by gunshot violence, I am convinced that, as a general rule, it is better to perform amputation; but, if this be not done, and an attempt is to be made to save the member, it will be more humane, when the army is retreating, and the enemy are not savages, to leave such wounded behind, than subject them to all the fatal mischief of hastily and roughly transporting them in such a condition. It gives me particular pleasure to find the preceding sentiment confirmed by Dr. Hennen, whose knowledge and experience in military surgery entitle all his opinions to the greatest attention: in noticing what ought to be done with the wounded when the army is compelled to retreat, he says, "it then becomes the duty of a certain proportion of the hospital staff to devote themselves for their wounded, and become prisoners of war along with them; and it may be an encouragement to the inexperienced, while it is grateful to me, to observe, that I have never witnessed, nor traced, on inquiry, an act of unnecessary severity practised either by the French or English armies on their wounded prisoners."

Compound fractures of the thigh, produced by gunshot violence, too often have an unfavourable termination, especially when the accident has been caused by grape-shot, or even a musket-ball, fired from a moderate distance, and the patient is moved from one place to another after the receipt of the injury. In the military hospital at Oudenbosch, in the spring of 1814, I had charge of about eight bad compound fractures of the thigh, of which cases only one escaped a fatal termination. This was an instance in which the femur was broken a little way above the knee. Another patient was extricated by amputation from the perils immediately arising from the splintered displaced state of the bone, the serious injury of the muscles, and enormous abscesses, but was unfortunately lost by secondary hemorrhage. All these patients had not merely been struck by grape-shot, or else by balls fired from a short distance, but they had been moved from Bergen-op-Zoom into the hospital, five or six days after the receipt of the injury—the worst period possible, on account of the inflammation being then most violent. From the ill success of these cases, many a surgeon who saw them might be inclined to think, that immediate amputation ought generally to be performed for all compound fractures of the thigh, as soon after the receipt of the injury as possible. And such is my own sentiment, whenever the accident has been caused in the violent manner above specified, or whenever the patient must be moved any distance in a waggon after the occurrence of the injury. It may be right to state, however, that I have known more than one compound fracture of the thigh cured, where the accident had not been occasioned by gunshot violence, and I have been informed of one or two successful cases, where the bone was broken by a pistol-ball. In St. Bartholomew's Hospital, two compound fractures of the thigh were formerly pointed out to me, as cases likely to end favourably. However, these may only have been lucky escapes, deviations from what is common, and not entitled to any stress, with the view of affecting the general excellent rule of amputating where the thigh-bone is broken by gunshot violence.

As Mr. Guthrie has accurately observed, one circumstance which increases the danger of fractures of the femur from gunshot violence, is, that the bone is often broken obliquely, the fracture extending far above and below the point immediately struck by the ball. (*On Gunshot Wounds*, p. 189, 190.) This disposition of the thigh-bone to be splintered for several inches when hit by a ball, and the increased danger arising from the occurrence, are particularly commented upon by the experienced Schmucker, who was surgeon-general to the Prussian armies in the campaigns of Frederick the Great. (See his *Vermischte Chirurgische Schriften*, b. i. p. 39. 8vo. Berlin, 1785.) In several of the cases, under the care of the late Dr. Cole and myself in Holland, the bone was split longitudinally, to the extent of seven or eight inches.

According to Schmucker, all fractures of the middle or upper part of the femur are attended with great danger. "But (says he) if the fracture be situated at the lowest part of the bone, the risk is considerably less, the muscles here not being so powerful; in such a case, therefore, amputation should not be performed before every other means has been fairly tried; and very frequently I have treated fractures of this kind with success, though the limbs sometimes continued stiff. But (says Schmucker) if the bone be completely fractured or splintered by a ball at its middle, or above that point, I never wait for the bad symptoms to commence, but amputate ere they originate, and, when the operation has been done early enough, most of my patients have been saved. However, when some days had transpired, and inflammation, swelling, and fever had come on, I must candidly confess, that the issue was not always fortunate. Yet the operation should not, on this account, be dispensed with; for, if only a few can thus be saved out of many, some benefit is obtained, as, without this step, such few would also perish." (*Vermischte Chir. Schriften*, b. i. p. 42.) What I saw of compound fractures of the thigh, after the assault on Bergen-op-Zoom, we may remark, coincides with the results of Schmucker's ample experience; for the only two patients who survived the bad symptoms proceeding directly from the fracture, were, one whose femur was broken near the knee, and another, whose limb I took off, on account of a fracture of the middle of the bone, accompanied with abscesses of surprising extent. The latter was a case, however, in which the limb ought to have been removed earlier. The following remarks, by Mr. Guthrie, I consider judicious and correct.

"The danger and difficulty of cure, attendant on fractures of the femur from gunshot wounds, depend much on the part of the bone injured; and, in the consideration of these circumstances, it will be useful to divide it into five parts. Of these, the head and neck included in the capsular ligament, may be considered the first; the body of the bone, which may be divided into three parts; and the spongy portion of the lower end of the bone exterior to the capsular ligament, forming the fifth part. Of these, the fractures of the first kind are, I believe, always ultimately fatal, although life may be prolonged for some time. The upper third of the body of the bone, if badly fractured, generally causes death at the end of six or eight weeks of acute suffering. I have seen few escape, and then not with a useful limb, that had been badly fractured in the middle part. Fractures of the lower or fifth division are in the next degree dangerous, as they generally affect the joint; and the least dangerous are fractures of the lower third of the body of the bone. Of these, even, I do not mean to conceal, that, when there is much shattered bone, the danger is great; so that a fractured thigh by gunshot, even without particular injury of the soft parts, is one of the most dangerous kinds of wounds that can occur." (See *Guthrie on Gunshot Wounds*, p. 190.)

In compound fractures, as Mr. Pott has correctly pointed out, there are three points of time when amputation may be proper. The first of these is immediately, or as soon as possible, after the receipt of the injury. The second is, when the bones continue for a great length of time without any disposition to unite, and the discharge from the wound has been so long, and is so large, that the patient's strength fails, and general symptoms foreboding dissolution come on. The third is, when mortification has taken such complete possession of the soft parts of the inferior portion of the limb, quite down to the bone, that, upon the separation of such parts, the bone or bones are left bare in the interspace.

The first and second of these are matters of very serious consideration. The third hardly requires any.

When a compound fracture is caused by the passage of a heavy body over a limb, such, for instance, as the broad wheel of a waggon or loaded cart, or by the fall of a very ponderous body on it, or by a cannon-shot, or by any other means so violent as to break the bones into many fragments, and so to tear, bruise, and wound the soft parts, that there shall be good reason to fear that there will not be vessels sufficient to carry on the circulation with the parts below the fracture, it becomes, as Mr. Pott observes, a matter of the most serious consideration, whether an attempt to save such a limb will not occasion loss of life. This consideration must be given before any degree of inflammation has seized the part, and, therefore, immediately after the accident. When inflammation, tension, and a disposition to gangrene in the limb have arisen, the period is highly disadvantageous for operating, and the patient's chances of being saved by amputation, under these circumstances, are much smaller than before the changes here spoken of have taken place. At the same time, there are certain examples of mortification from external causes, where, as far as one can judge from the results of later experience than that of Mr. Pott, the surgeon should not defer amputation, even though the disorder is yet in a spreading state, attended with considerable swelling and tension reaching far up the limb. This is a subject, however, which will require more explanation hereafter. (See what is presently said on *Mortification.*) Nor are the cases, to which reference is made, meant to affect the general truth of the observation, delivered by the most experienced surgeons of every age, that, when a limb is extensively swelled and inflamed, with a part of it either in a state of spreading mortification, or ready to become gangrenous, the period is so unfavourable for amputation, that very few patients, so circumstanced, ever recover after the operation. Nor is it meant to be insinuated, that, in the very cases, which form exceptions to the general rule of not amputating before the tendency to gangrene has ceased, the patient might not have had an infinitely better chance of his life, had the operation been done immediately after the first receipt of the injury, before any disposition to gangrene had had time to be produced.

The necessity of immediate or very early decision, in this case, makes it a delicate part of practice; for, however pressing the case may seem to the surgeon, it will not, in general, appear in the same light to the patient or his relations; yet suffering this point of time to pass often decides the patient's fate.

This necessity of early decision arises from the quick tendency to mortification, which ensues in the injured limb, and too often ends in the patient's death. That this is no exaggeration, says Pott, melancholy and frequent experience evinces, even in those whose constitutions, previous to the accident, were in good order; but much more in those, who have been heated by violent exercise, or labour, or liquor, or who have led debauched and intemperate lives, or who have habits naturally inflammable and irritable. This is often the case when the fracture happens to the middle part of the bones, but is much more likely to happen when any of the large joints are concerned. In many of these cases, a determination for or against amputation, is really a determination for or against the patient's existence.

That it would have been impossible to have saved some limbs, which have been cut off, no man will pretend to say; but this does not render the practice injudicious. Do not the majority of those who get into the above hazardous condition, and on whom amputation is not performed, perish in consequence of their wounds? Have not many lives been preserved by amputation, which, from the same circumstances, would otherwise most probably have been lost?

Pressing and urgent as the state of a compound fracture may be, at this first point of time, still it will be a matter of choice, whether the limb shall be removed or not; but, at the second period, the operation must be submitted to, or the patient must die.

The most unpromising appearances at first do not necessarily, or constantly, end unfortunately. Sometimes, after the most threatening first symptoms, after considerable length of time, great discharges of matter, and large exfoliations of bone, success is ultimately obtained, and the patient recovers his health and the use of his limb.

Dupuytren relates two cases, in one of which the hand was terribly shattered by the kick of a horse; while, in the other, all the anterior part of the foot had been crushed by an iron machine. In the first case, all the parts of the hand, not broken to atoms, were preserved, the patient recovering without any severe symptoms. In the second, where the great toe was broken, and the first and second metatarsal bones comminuted, the other toes wounded, and all the integuments of the sole torn away, gangrene ensued; but, in the end, the patient recovered with the loss of only the great toe. In both these instances, Dupuytren removed all loose fragments of bone. In the last case, he was singularly favoured by the youth and good constitution of the patient. "Things," says he, "do not always end in this way: a very slight difference in these favourable conditions, or in the degree of the injuries, might perhaps have made us seriously repent of not having amputated." (*Clin. Chir.* t. iv. p. 237.)

But sometimes, after the most judicious treatment through every stage of the disease; after the united efforts of physic and surgery; the sore, instead of granulating kindly, and contracting daily to a smaller size, shall remain as large as at first, with a tawny, spongy surface, discharging a large quantity of thin sanies, instead of a small one of good matter; the fractured ends of the bones, instead of tending to exfoliate, or to unite, will remain as perfectly loose and disunited as at first, while the patient shall lose his sleep, his appetite, and his strength; a hectic fever, with a quick, small, hard pulse, profuse sweats, and colliquative purging, contributing at the same time to bring him to the brink of the grave, notwithstanding every kind of assistance: in these circumstances, if amputation be not performed, Mr. Pott asks, what else can rescue the patient from destruction?

The third and last period is a matter which does not require much consideration. Too often, the inflammation, consequent upon the injury, instead of producing abscess and suppuration, tends to gangrene and mortification, the progress of which is often so rapid, as to destroy the patient in a short space of time, constituting that very sort of case, in which amputation should have been immediately performed. But sometimes even this dreadful malady is, by the help of art, put a stop to, but not until it has totally destroyed all the surrounding muscles, tendons, and membranes quite down to the bone, which, upon the separation of the mortified parts, is left quite bare, and all circulation between the parts above and those below is by this totally cut off. In this instance, whether the surgeon saw through the bare bone, or leave the separation to be effected by nature, the patient must lose his limb. (See *Pott's Remarks on the Necessity, &c. of Amputation in certain Cases, &c. Chir. Works*, vol. iii.)

For the consideration of a variety of complicated circumstances affecting the question of amputation in compound fracture, I must refer to Gunshot Wounds.

2. EXTENSIVE CONTUSED AND LACERATED WOUNDS.

These form the second class of general cases requiring amputation. Wounds without fracture are not often so bad as to require this operation. When a limb, however, is extensively contused and lacerated, and its principal blood-vessels are injured, so that there is no hope of a continuance of the circulation, the immediate removal of the member should be recommended, whether the bones be injured or not. Also, since no effort on the part of the surgeon can preserve a limb, so injured, and such wounds are more likely to mortify than any others, the sooner the operation is undertaken the better.

In these cases, as in those of compound fractures, though amputation may not always be necessary at first, it often becomes so afterwards. The foregoing observations, relative to the second period of compound fractures, are equally applicable to badly lacerated wounds, unattended with injury of the bones. Sometimes a rapid mortification comes on; or a profuse suppuration, which the system can no longer endure.

For information on the proper period of amputating in traumatic gangrene, see MORTIFICATION, and the section on this disorder in the present article.

3. CASES IN WHICH PART OF A LIMB HAS BEEN CARRIED AWAY BY A CANNON-BALL.

When part of a limb has been torn off by a cannon-ball, or any other cause capable of producing a similar effect, the formation of a good and serviceable stump; the greater facility of healing the clean, regular wound of amputation; and the benefit of a far more expeditious, as well as of a sounder cure, are the principal reasons which here make the operation advisable.

This was an instance, in which some former surgeons disputed the necessity of amputation. They urged as a reason for their opinion, that the limb being already removed, it is better to endeavour to cure the wound as speedily as possible, than increase the patient's sufferings and danger, by making him submit to amputation. It must be remembered, however, that the bones are generally shattered, and reduced into numerous fragments; the muscles and tendons are unequally divided, and their ends torn and contused. Now, none of the old surgeons questioned the absolute necessity of extracting the splinters of bone, and cutting away the irregular extremities of the tendons and muscles, which operations would require a longer time than amputation itself. Besides, we should recollect, that, by making the incision above the injured part, so as to be enabled to cover the bone with flesh and integuments perfectly free from injury, the extent of the wound is so diminished, that the healing can be accomplished in one third of the time which would otherwise be requisite, and a much firmer cicatrix is also obtained. Such reflections must convince us that amputation here holds forth great advantages. It cannot increase the patient's danger; and as for the momentary augmentation of pain which he suffers, he is amply compensated. (See GUNSHOT WOUNDS.)

4. MORTIFICATION.

Mortification is another cause, which, when advanced to a certain degree, renders amputation indispensably proper. We have noticed, that bad compound fractures, and wounds, often terminate in the death of the injured limb. Such surgeons as have determined, at all events, to oppose the performance of amputation, have pretended that the operation is here totally useless. They assert, that when the mortification is only in a slight degree, it may be cured; and that when it has spread to a considerable extent, the patient will perish, whether amputation be performed or not. But this way of viewing things is so contrary to facts, and the experience of every impartial practitioner, that I shall make no attempt to refute the assertion. While it is allowed that it would be very bad practice to amputate on every slight appearance of gangrene, it is equally a fact, that, when the disorder affects the substance of a member, the operation is generally the safest and most advantageous measure. Nay, there are, as we shall presently see, certain forms of mortification, in which the early performance of amputation is the only chance of saving the patient.

Practitioners have entertained very opposite opinions concerning the period when one should operate in cases of mortification. Some pretend that whenever the disorder presents itself, and especially when it is the effect of external violence, we should amputate immediately the mortification has decidedly begun to form, and while the mischief is in a spreading state. Others believe that the operation should never be undertaken before the progress of the disorder has stopped, even not till the dead parts have begun to separate from the living ones.

The advocates for the speedy performance of amputation declare, that the further progress of the mortification may be stopped, and the life of the patient preserved, by cutting above the parts affected. However, according to the reports of the greater number of eminent surgical writers, this practice is highly dangerous, and undeserving of confidence. Whatever pains may be taken, in the operation, only to divide sound parts, there is no certainty of succeeding in this object, and the most skilful practitioner may be deceived. The skin may appear to be perfectly sound and free from inflammation, while the muscles which it covers, and the parts immediately surrounding the bone, may actually be in a gangrenous state. But even when the soft parts are found free from apparent distemper on making the incision, still, if the operator should not have waited till the mortification has ceased to spread, the stump will almost always be attacked by gangrene. Surgeons who have had opportunities of frequently seeing wounds which have a tendency to mortify, entertain the latter opinion. Such was the sentiment of Pott, who says that he has often seen the experiment made, of amputating a limb in which gangrene had begun to show itself, but never saw it succeed, and it invariably hastened the patient's death.

The operation may be postponed, however, too long. Mr. S. Sharp, in particular, recommended too much delay, advising the operation never to be undertaken till the natural separation of the mortified parts had considerably advanced. Mr. Sharp was a surgeon of immense experience, and his authority carries with it the greatest weight. But, perhaps, he was too zealous in his opposition to a practice, the peril of which he had so often beheld. When the mortification has ceased to spread, there is no occasion for further delay. We now obtain, just as certainly, all the benefits of the operation, and get rid of a mass of putridity, the exhalations from which poison the atmosphere which the patient breathes, and are highly detrimental to his health. Nay, patients in these circumstances may actually fall victims to the absorption of putrid matter. However, this danger would not be so considerable as that which would arise from too precipitate an operation; and it is better to defer amputation a little more than is absolutely requisite, than run any risk of performing the operation before it is certain that the parts have lost their tendency to gangrene.

In the article Mortification, we have noticed particular cases of gangrene, where, according to Larrey's experience, the surgeon is not to wait for the line of separation being formed, but have recourse to the immediate performance of amputation. The experience of Mr. Lawrence, and several cases which I saw in the British military hospitals during the last war, tend to confirm the propriety of such practice. (See *Medico-Chir. Trans.* vol. vi. p. 156, &c.)

In an example, where a large part of the arm was deeply affected with gangrene from external violence, and the disorder was yet making rapid progress, I once recommended the performance of amputation at the shoulder-joint. On the whole, this instance was favourable to the practice; for, though the patient died at the end of a fortnight, probably he would not have lived twenty-four hours, had the operation not been done; nor was the stump attacked with mortification, — a circumstance worthy of attention, because it is a danger particularly insisted upon by the opponents of amputation under the preceding circumstances; and, had it not been for a large abscess, which formed in the back, as was supposed, from a violent blow received in the fall which produced the original injury, there were well-grounded hopes of recovery. The patient, here spoken of, was attended by Dr. Blicke, of Walthamstow.

There is likewise a species of gangrene, which is pointed out by Mr. Guthrie as requiring early amputation. "A soldier (says he) shall receive a flesh-wound from a musket-ball in the middle of the thigh, which passes through the limb apparently, on a superficial inspection, without injuring the main artery; or it shall pass close behind the femur, where the artery turns to the back part of the bone; or it may go through the middle of the bone, from behind forwards, between the condyles of the femur, into the knee-joint, and the patient shall walk to the surgeon with little assistance, be superficially dressed, and, in many cases, considered slightly wounded; yet the femoral artery and vein, in the whole of these cases, and, indeed, in many others, shall be wounded, or cut across, and the local inflammation be so slight as to obtain little attention. On the third or fourth day, the patient shows his toes discoloured, and complains of pain and coldness in the limb below the wound, the constitution begins to sympathise with the injury, and the surgeon probably thinks the case extraordinary. Perhaps he suspects the real state of the injury; but is surprised that a wound of the femoral or popliteal artery, with so little attendant injury, could cause mortification, &c. He is anxious to do something; but mortification, or at least gangrene, having commenced, he must, according to general rule, await the formation of the line of separation. The temperature of the leg, a little above the gangrene, is good, perhaps higher than natural; he hopes it will not extend farther, and it probably does remain stationary for a little time. At last, the parts originally affected—the toes—become sphacelated, and gangrene quickly spreads up the leg as far as the wounded artery, by which time the patient dies."

For the purpose of preventing such a disaster, where the artery, or artery and vein, have been divided, Mr. Guthrie recommends the performance of amputating as soon as the gangrene is perceived to extend beyond the toes; and the swelling and slight attendant inflammation, which is marked more by the tumefaction than the redness of the part, has passed higher up than the ankle. (See *Guthrie on Gunshot Wounds*, p. 60, 61.)

Mortification of a limb, after operation for aneurism, is another exception to the general rule of not amputating till the mortification has stopped. Where also gangrene arises from the obstruction of the circulation, by an aneurism bursting, and its blood passing copiously into the cellular tissue of the limb, amputation should be performed without delay, though the mortification may not have stopped. An example of the success of this practice, I have laid before the profession. (See *Med. Chir. Trans.* vol. xvi.)

5. Diseased Joints.

Excluding from present consideration the proposal to undertake the excision of some joints which are in particular states of injury, or disease, I may observe, that scrofulous joints, with diseased bones, and distempered ligaments and cartilages, is another case in which amputation may become absolutely necessary. As Mr. Pott remarks, there is one circumstance attending this complaint, often rendering it particularly unpleasant, which is, that the subjects are most frequently young children, so as to be incapable of determining for themselves; which inflicts a distressing task on their nearest relations. All the efforts of physic and surgery often prove absolutely ineffectual, not only to cure, but even to retard the disease in question. Notwithstanding many cases admit of cure, numerous others do not. The disease often begins in the very inmost recesses of the cellular texture of the heads of the bones, forming the large articulations, such as the hip, knee, ankle, and elbow; the bones become diseased in a manner which will be explained in the article Joints, sometimes with great pain and symptomatic fever; sometimes with little of either, at least in the beginning. The cartilages covering the ends of these bones, and designed for the mobility of these joints, are totally destroyed; the epiphyses in young subjects are either partially, or totally separated from the said bones; the ligaments of the joints are so thickened and spoiled by the distemper, as to lose all natural appearance, and become quite unfit for all the purposes for which they we intended: the parts appointed for the secretion of the synovia, become distempered in like manner. All these together furnish a large quantity of stinking sanious matter, which is discharged either through artificial openings, made for the purpose, or through small ulcerated ones. These openings commonly lead to bones which are diseased through their whole texture. When the disease has got into this state, the constant pain, irritation, and discharge bring on hectic symptoms of the most destructive kind, such as total loss of appetite, rest, and strength, profuse night sweats, and as profuse purgings, which foil all the efforts of medicine, and bring the patient to the brink of destruction. (See *Pott on Amputation.*)

In these cases, amputation is attended with more success when performed late, than when undertaken at an early period, before the disease has made great advances. This is fortunate, as it affords time for a fair trial of such remedies as are best calculated to check the progress of the disorder. (See Joints.)

Whenever the disease of a joint is likely to terminate in anchylosis, amputation should not be resorted to, as a cure will be effected without it (See Anchylosis.) In deciding to amputate, or not, a great deal will depend upon the state of the patient's health, and his kind of constitution, as well as upon the condition of the joint itself. Thus, Depuytren relates the particulars of two cases of diseased elbow, with ulceration of the cartilages, abscesses, sinuses, &c. In one, where the constitution was decidedly scrofulous, the hectic disturbance severe, the emaciation great, and the strength rapidly declining, the patient, a child, could only be saved by amputation. In the other case, where the constitution was less deranged, and the strength better maintained, Dupuytren brought the disease to a conclusion by anchylosis. (See *Dupuytnen, Clin. Chir.* t. iv. p. 250.)

6. Exostosis

May render amputation necessary, when the tumour becomes hurtful to the health, or insupportable, on account of its weight, or other circumstances, and cannot be removed by any of the plans specified in the article Exostosis.

7. Necrosis.

Another distemper, sometimes producing a necessity for amputation, is necrosis, or the death of the whole, or of a considerable part, of the bones of the extremities, accompanied with such extensive abscesses, such disease of the soft parts, such disorder of the constitution, and prostration of strength, that every hope of a cure being effected by a natural process must be renounced. By necrosis, is here meant, not merely some disease which destroys the surface of a bone, but one which extends its depredations to the whole of the internal substance, and that from end to end. Portions of the bones die from a variety of causes, such as struma, lues venerea, deep-seated abscesses, pressure, &c.; and bones in this state, when properly treated, often exfoliate and cast off their dead parts. But, when the whole substance of a bone becomes diseased, from end to end, frequently no means will avail. In the words of Mr. Pott, the use of the scalpel, the raspatory, and the rugine, for the removal of the diseased surface of bones; of the trephine, for perforating into the internal texture of the diseased bone, and of exfoliating applications (if there be any such which merit the name), will prove in many instances unavailing, and, unless the whole bone be removed by amputation, the patient will die. Mr. Pott's refutation of Bilguer, who asserts that amputation is not requisite in these instances, is a masterly and most convincing production; but I would not exactly do as the former of these writers has done, and positively affirm, that every extensive necrosis, affecting a bone nearly its whole length, must inevitably require amputation. The power of nature in restoring the bones is sometimes wonderful. (See Necrosis.)

The late period, at which an extensive necrosis may follow the injury of a bone, and make amputation necessary, is sometimes almost incredible. Schmucker details the case of a captain who received a musket ball through the left arm, four or five inches above the elbow. The bone was violently struck, but not broken; several exfoliations followed, and after more than a year's treatment, the patient appeared perfectly cured. For nine years this officer remained well; but at the end of this time, being on a journey, he was attacked with pain and inflammation in the wounded part, and febrile symptoms. He hastened to Berlin, and put himself under the care of Theden and Schmucker, who found an abscess in the situation of the former wound, and, as an opening had been already made, the bone could be felt stripped of its periosteum. At length, a piece of bone exfoliated, and became loose, precisely under the brachial artery, which interfered with its removal. Notwithstanding the discharge, the elbow-joint continued swelled, and there were red points observable, not only above that joint, but also over the heads of the ulna and radius, indicating disease of those bones. Amputation was therefore performed by Theden, and the patient got quite well. On examining the os brachii a splinter was found, three inches in length, and one in breadth, its edges being thin and sharp, while its centre was more than three lines thick. The bone, every where about the place, where it had been struck by the ball, seemed to consist of callus without any medullary cavity, and the whole of it down to the elbow had no periosteum. The cartilage appeared also disposed to separate, and the periosteum was detached from the radius and ulna, which were likewise affected with necrosis. (See *Schmucker's Vermischte Chir. Schriften*, b. i. p. xxiii. ed. 2.)

When, in a case of necrosis, the limb breaks in the midst of the diseased part of it, followed by vast deformity, profuse suppuration, and urgent constitutional derangement, amputation is indicated. (See *Dupuytren, Clin. Chir.* t. iv. p. 260.)

8. Cancerous and other inveterate Diseases, such as Fungus Hæmatodes.

Cancerous, inveterate diseases, and malignant incurable ulcers on the limbs, sometimes render amputation a matter of necessity. In treating of cancer, we shall remark, that little or no confidence can be placed either in internal or any kind of topical remedies, and that there is nothing except the total separation of the part affected, upon which any rational hopes of cure can be built. Cancer, attended with scirrhous formation, is not frequently seen on the extremities. Every man of experience, however, must occasionally have seen, in this situation, if not *scirrhoma*, as it is termed by Dr. Carswell (see his *Illustra-*

tions of the Elementary Forms of Disease, Fasc. 1. et 2.) medullary tumours, and other diseases quite as intractable, and which cannot be cured, except by removing the affected part. This may often be accomplished without cutting off the whole limb. But, when the disease has spread beyond certain bounds, amputation, above the part affected, is the only thing to which recourse can be had with any hope of success. Sometimes, when the operation has been delayed too long, even amputation itself will not effect a cure. In a few cases of medullary tumour, the operation has succeeded, however; and even after the disease had reappeared, a cure has now and then been achieved by another excision of the diseased parts. Yet, from what I have seen of fungus hæmatodes, I should much doubt, whether the benefit obtained by amputation would frequently be lasting, as when this disease shows itself only externally, internal organs are mostly at the same time similarly affected. (See Fungus Hæmatodes.)

Besides cancerous, there are other ulcers, which may render amputation indispensable. Thus, when an extensive ulcer, of any sort whatsoever, is evidently impairing the health; when, instead of yielding to remedies, it becomes larger and more inveterate; when, in short, it puts life in imminent danger; amputation should be advised. In phagedenic ulcers from syphilis, and others attacked by hospital gangrene, the operation would be improper. (See Hospital Gangrene, and Venereal Disease.)

9. Various Tumours.

That there are numerous swellings which destroy the texture of the limbs, rendering them useless, causing dreadful sufferings, and bringing the patients into the most debilitated state, no man of observation can fail to have seen. When such tumours can neither be dispersed, nor cut out with safety, amputation of the limb is the only resource.

Mr. Pott has particularly described a tumour affecting the leg, for which the operation is sometimes requisite. It has its seat in the middle of the calf of the leg, or rather more towards its upper part, under the gastrocnemius and soleus muscles. It begins by a small, hard, deep-seated swelling, sometimes very painful, sometimes but little so, and only hindering the patient's exercises. It does not alter the natural colour of the skin, at least until it has attained a considerable size. It enlarges gradually; does not soften as it enlarges, but continues through the greatest part of it incompressibly hard, and, when it is got to a large size, it seems to contain a fluid, which may be felt towards the bottom, or resting, as it were, on the back part of the bones. If an opening be made for the discharge of this fluid, it must be made very deep, and through a strangely distempered mass. This fluid is generally small in quantity, and consists of a sanies mixed with grumous blood: the discharge of it produces little diminution of the tumour, and high symptoms of irritation and inflammation come on; and, advancing with great rapidity, and most exquisite pain, soon destroy the patient, either by the fever, which is high and unremitting, or by a mortification of the whole leg. If amputation has not been performed, and the patient dies, after the tumour has been freely opened, the mortified and putrid state of the parts prevents all satisfactory examination; but, if the limb was removed without any previous operation (and which Mr. Pott, in his experience, found to be the only way of preserving the patient's life), the posterior tibial artery will be found to be enlarged, distempered, and burst; the muscles of the calf to have been converted into a strangely morbid mass; and the posterior part of both the tibia and fibula more or less carious.

The following case is related by Mr. Abernethy. A woman was admitted into St. Bartholomew's Hospital with a hard tumour in the ham. It was about four inches in length, and three in breadth. She had also a tumour in front of the thigh, a little above the patella, of lesser size and hardness. The tumour in the ham, by its pressure on the nerves and vessels, had greatly lessened the sensibility, and obstructed the circulation of the leg, so that the limb was very œdematous. As it appeared impossible to remove this tumour, and its origin and connections were unknown, amputation was performed. On examining the amputated limb, the tumour in the ham could only be divided with a saw. Several slices were taken out of it by this means, and appeared to consist of a coagulable and vascular substance, in the interstices of which a great deal of bony matter was deposited. The remainder of the tumour was macerated, and dried, and it appeared to be formed of an irregular and compact deposition of the earth of bone. The tumour on the front of the thigh was of the same nature as that of the ham, but contained so little lime that it could be cut with a knife. The thigh bone was not at all diseased, which is mentioned, because, when bony matter is deposited in a limb, it generally arises from the disease of a bone. (*Surgical Observations*, 1804.)

Before the late facts and improvements, relative to the treatment of aneurisms on the extremities, these cases were generally set down as requiring amputation. Even Pott, and J. L. Petit, wrote in recommendation of such practice, and their observations on this subject are among the few parts of their writings which the enlargement of surgical knowledge, since their time, has rendered objectionable. The surgeon, to whom the honour of first correcting this erroneous doctrine belongs, is A. N. Guenault, who opposed the advice delivered by Petit. (*Haller, Disp. Chir.* vol. v. p. 155.)

I shall conclude these remarks on the cases requiring amputation, with advising surgeons never to undertake this serious operation without consulting the opinions of other professional men, whenever their advice can be obtained. The best operators are often deficient in that invaluable kind of judgment, by which the cases, absolutely demanding amputation, are discriminated from others, in which the operation may be wisely postponed, and a chance taken of preserving the limb.

Surgeons should generally refuse to amputate limbs merely affected with stiffness or deformity. Operations, under such circumstances, termed by the French *opérations de complaisance*, are more frequently followed by fatal consequences, than amputations in more urgent cases. (See *Dupuytren, Clin. Chir.* t. iv. p. 271.)

The History of Amputation

Evinces, that the steps of surgery to perfection are slow, and that they even sometimes deviate from the straight path, though, upon all essential points, no retrogradation has ever taken place. Here nature has acted as the guide, and the surgeon's chief merit has consisted in obeying the hints which she herself has thrown out. As already mentioned, the following natural occurrence, no doubt, was one of the circumstances which first led to the bold practice of amputation: in consequence of disease, and grievous local injuries, whole limbs were sometimes seized with mortification. In the majority of cases this was attended with so much constitutional disturbance, that the patients died; but, in other instances, the mortification was confined to the part; suppuration was established between the dead and living parts; the whole of the mortified limbs fell off; the suppurating surfaces healed up; and thus, by the powers of nature, the patients were restored to health. Here was clearly proved the possibility of recovery, notwithstanding the loss of a limb. The surgeon, as Brünninghausen remarks, viewed with surprise this course of nature, and hardly ventured to promote it by the feeble means formerly employed. But, as the mortified parts, previously to their detachment, caused great annoyance by their fetor, a surgical attempt was at length made to get rid of them; in doing which, the knife was always kept from touching the living flesh, on account of a well-grounded fear of bleeding, for the suppression of which no effectual methods were known. Such was the practice that prevailed from Hippocrates down to Celsus. (*Erfahr. &c. über die Amp.* p. 14.)

A. C. Celsus, who lived in the reign of Tiberius, and whose book, *De Re Medicâ*, should be read by every surgeon, has left us a short description of the mode of amputating gangrenous limbs. (Lib. vii. c. 33.) It has been often remarked, that Celsus has left no instructions for securing the divided blood-vessels; but it has not been commonly noticed, that, in his chapter on wounds, he directs us to stop hemorrhage by taking hold of the vessels, then tying them in two places, and dividing the intermediate portion. If this measure cannot be adopted, he advises the use of a cauterizing iron. Several hints are to be met with in the writings of Celsus, from which it may be inferred, that the ligature of bleeding vessels was sometimes practised at the early age in which he lived; and this supposition is strengthened, by a fragment of Archigenes, preserved by Cocchius, on the subject of amputation, where he speaks of tying, or sewing, the blood-vessels. We are not, however, in possession of all the writings of medical authors, prior to the time of Galen, and must therefore remain in doubt upon this point. (*Rees's Cyclopædia*, art. *Amputation.*)

This anonymous writer argues, therefore, with some appearance of reason, that if amputation often proved fatal in the days of Celsus,—"sæpe in ipso opere," as the expression is,—it was owing to the want of some efficacious method of compressing the blood-vessels during the operation itself.

But, admitting that the ancients were not altogether uninformed of the plan of tying arteries, it cannot be credited, that they adopted the practice to any extent; for, if they had, they would not have continued so partial to the cautery, boiling oils, and a farrago of astringent applications. They would also never have had recourse to the barbarous method of cutting the flesh with a red-hot knife, with the view of stopping the hemorrhage by converting the whole surface of the stump into an eschar. Painful in its execution, and horrid in its consequence, as this burning operation was, it seldom proved a lasting antidote to the bleeding, which generally came on in a fatal manner, as soon as the sloughs were loose. On this part of the subject my own ideas fully agree with those of a distinguished foreign surgeon, who says, that although the document left us may prove that the ligature was known to the ancients, and employed in cases of aneurisms and wounded blood-vessels, nay, that the arteries were secured with a needle and ligature; yet the practice could not have been extended to the operation of amputation, since, with the custom of making the incisions in the dead parts, the method scarcely admitted of being put in execution. (*Brünninghausen, Erfahr. über die Amput.* p. 29.)

The different steps of the operation, meriting particular attention, are, the choice of the part of the limb where the incisions are to begin; the measures for guarding against bleeding during the operation; the division of the integuments, muscles, and bones, which is to be accomplished in such a manner, that the whole surface of the stump will afterwards be covered with skin; tying the arteries, which should be done without including the nerves, or any other adjacent part; placing the integuments in a proper position after the operation; and, finally, the subsequent treatment of the wound.

At the period of making the incision, the ancients contented themselves with having the skin forcibly drawn upward by an assistant; they next divided, with one sweep of the knife, the integuments and flesh down to the bone, and, afterwards, sawed the bone on a level with the soft parts which were drawn upward. Celsus considered it better to let the incision encroach upon the living flesh, than leave any of the diseased parts behind. "*Et potius ex sanâ parte aliquid excidatur, quam ex ægrâ relinquatur.*" (*De Medicinâ*, lib. vii. c. 33.)

It appears, however, that his views extended further than those of most of his contemporaries, and even his followers, almost down to modern times. After cutting the muscle down to the bone, he says, that *the flesh should be reflected, and detached underneath with a scalpel, in order to denude a portion of the bone which is then to be sawn as near as possible to the healthy flesh, which remains adherent.* He states that, when this plan is pursued, *the skin around the wound will be so loose, that it can almost be made to cover the extremity of the bone.* It is to be lamented, that this advice, inculcated by Celsus, should not have been comprehended, or that it should have been so neglected as to stand in need, as it were, of a new discoverer. But, the fact is, that hemorrhage formerly rendered amputation so dangercus, that the ancient surgeons could not devote much attention to any thing else in the operation, and practitioners amputated so seldom, that we read in Albucasis, that he positively refused to cut off a person's hand, lest a fatal hemorrhage should ensue, and the patient did it himself and recovered. Over that part of the stump which the small quantity of preserved skin would not cover. Celsus recommended compresses, and a sponge dipped in vinegar to be laid. (*De Re Medicâ*, lib. vii. c. 33.)

Archigenes, born at Apamia in Syria, was the disciple of Agathinus, and physician to Philip, king of that country. He repaired to Rome, where he practised physic and surgery in the reign of the emperor Trajan, about 108 years after the birth of Christ. (*Portal, Hist. de l'Anatomie et de la Chirurgie*, t. i. p. 61.) In the history of amputation, the name of Archigenes is conspicuous; for he is supposed to have been the first to apply a circular ligature to the limb: he also wetted the whole member with cold water, for the prevention of loss of blood; and it is sometimes believed that he entertained some notion of previously taking up the vessels. Dupuytren observes, however, that this is very doubtful, because it would imply such anatomical knowledge of the circulation as did not exist at the early period alluded to. Archigenes imitated Celsus in the important point of making the incisions in the sound flesh. (*Nicet. Coll. Chir.* p. 155.; *Sprengel, Geschichte de Chir.* b. i. p. 404. Halle, 1805.) Such was likewise the practice of Heliodorus, who at this early period made objections to the plan of cutting off a limb by a single stroke,—a proposal that was renewed in far later days. The same author has also spoken of amputating at the joints; a method of which he disapproves. (*Nicet. Coll. Chir.* p. 155.) However, Galen entertained a favourable opinion of it. (*Com.* 4. in lib. *de Artic.* p. 650.) Galen's precepts concerning amputation are, upon the whole, very like those of Hippocrates; for he directs only the dead parts to be cut, and the stump to be cauterized. (*De Arte Curativâ ad Glauconem*, lib. ii.) By all the old writers, amputation was entirely restricted to cases of mortification; further they were afraid to go; and this precept, and all the other doctrines of Galen, may be said to have been the guide of the whole surgical profession for at least fourteen centuries.

The timid Arabians were not partial to amputation; and even in cases of mortification, generally preferred a farrago of useless applications, like Armenian bole, &c. Paulus Ægineta, like Galen, deviated from Celsus's good rule of making the incisions in the healthy parts, and only approved of making the requisite division near them. (Lib. iv. c. 19. p. 140.) Avicenna repeated the directions left by the Greek writers (*Can.* lib. iv. Fen. 3. tr. 1. p. 454.), and Albucasis recommended the performance of the operation with a red-hot knife. (*Chirurg.* lib. i. sect. 52. p. 99.) In the middle ages, little was done for the improvement of amputation. But in the 14th century, gunpowder was invented, and soon applied to the purposes of war; so that an abundance of cases must have presented themselves, in which the wise maxim of not deferring amputation until mortification had come on, but of preventing the mischief by the operation, ought to have struck an intelligent surgeon. One might also have expected that practitioners would now have been led to make the incisions in the sound flesh. Unfortunately, the invention of gunpowder, and its immediate consequences in surgery, happened at a period when practitioners were ill qualified to profit by the new lessons of experience set before them. The writings of their predecessors furnished them with no directions how they ought to act, and they were themselves too much confounded at the sight of the mischief for which they were consulted, to be able to form any correct opinion about causes and effects. Their first idea was, that the terrible symptoms proceeded from the parts being actually burned, and they afterwards inclined to the belief that gunshot wounds were poisoned. Hence, the most absurd modes of treatment were instituted, and, as Brünninghausen expresses himself, human nature groaned under a new evil, for which there were for some time no judicious plans of relief. (*Erfahr. &c. über die Amp.* c. 19.) This deplorable state was the natural result of the depression of science in general, and of the healing art in particular, in the days to which I now refer. In these middle ages, as they are called, the population of all Europe was plunged in the deepest ignorance; and whatever little knowledge remained, either of the arts, or languages, was monopolized by the priesthood, the physicians of those times, who, instead of studying the volume of nature, wasted most of their time in discussing the doctrines of Galen. Surgery itself sunk to the lowest ebb, as may be well conceived from the decrees issued by pope Boniface the Eighth, forbidding any of the clergy to do any thing themselves which drew blood; and, of course, all the operative part of surgery was transferred to a set of illiterate, low-bred mechanics, far inferior to the worst country farriers of modern times. Yet, the clergy, who were thus scrupulously averse to soiling their own hands with blood, or hurting their own tender feelings by viewing the agony of their fellow-creatures, submitted to operations, had no hesitation in taking the chief emoluments and honours of the profession, or in turning over these poor sufferers to men more qualified to torture and murder, than give relief; and, what nearly staggers all credulity, the same professors of Christianity, who shuddered to spill a drop of blood themselves, on a proper occasion, as Haller observes, eagerly had a hand, and acted an important part, in every sanguinary war, where it was possible for them to interfere. In these dismal days of surgery, the advice delivered by Celsus was renewed by Theodoricus, who used to administer opium and hemlock previously to the operation, for the purpose of rendering the patient less sensible of pain, and afterwards vinegar and fennel were given, with the view of dispersing the intoxicating effects of the preceding medicines. (*Chirurg.* lib. iii. c. 10.)

The renowned Guido di Caulico was the inventor of the plan of taking off limbs without bloodshed. It is better, says he, for the limb to drop off, than be cut off. This practice consisted in covering the whole membrane with pitch plaster, and applying round one of the joints so tight a band that the parts below the constriction ultimately dropped off. (*Chirurg.* tr. 6. Doctr. 1. cap. 8.) The method of amputating, suggested by Celsus, was again revived by Gersdorf, who, after the operation, not only drew down over the stump the skin which had been retracted, but applied a hog's or bullock's bladder over the stump, so as to render all burning and stiching of the part needless. (*Feldbuch der Wundarzn.* fol. 63.) Bartholomew Maggi also endeavoured to preserve a considerable flap of integuments for covering the stump. (*De Vulner. Bombard. et Sclopet.* 4to.

Bonon. 1552; see *Sprengel's Geschichte der Chirurgie*, p. 404. 406. 8vo. Halle, 1805.)

At length, in the 15th century, when the revival of learning had commenced in Italy, medical practitioners began to think for themselves again, and they turned from compilations and scholastic nonsense, to the consideration of nature. Anatomy was cultivated with great ardour, and made brilliant progress under eminent characters of the time; De la Torre, Berengarius Carpi, Vesalius, Fallopius, Eustachius, and others, who were also for the most part very distinguished surgeons. "*In Italiâ scientiarum matre medici se nunquam chirurgia abdicarunt. Seculo 15 et 16, professores medici academiæ Bononiensis, Patavinæ, et aliarum in Italia illustrium scholarum et manu curaverunt, et consilio, et inter istos viros summi chirurgi extiterunt.*" (Haller, Bibl. Chir. b. i. p. 161.) Practitioners now ventured to amputate limbs in the sound part for other incurable diseases besides mortification; but the art of stopping hemorrhage after the operation continued imperfect. Though the method of applying the ligature in cases of wounded arteries and aneurisms was understood, yet, from some unaccountable causes, the practice was never thought of in amputation. Even Fallopius knew of no other means for stopping the bleeding but the cautery. (*De Tum. præternat.* p. 665.) On the whole, the stoppage of bleeding was not attended with a degree of success, proportionate to the advances of the healing art in general. Straps, bands, and compresses were, indeed, put round the member; but, as the circulation of the blood was not yet correctly known, they were not applied in the proper places; being arranged either close to the wound, or several of them put at random round the limb. The effect of such immoderately tight, long-continued constriction, could be nothing less than gangrene, and hence the actual cautery was chiefly employed. The other means for suppressing hemorrhage scarcely merit the name. Terrified at the insecurity and ill consequences, J. de Vigo (*Practica in Chirurgia copiosa*, 491. Romæ, 1514) and Fabricius ab Aquapendente (*Op. Chir.* Venet. 1619) disapproved of amputating in the sound flesh, and returned to the principle, inculcated by the ancients, of making the incision in the mortified parts. Others endeavoured to lessen the peril of the bleeding by the rapidity with which the limb was removed, and the instantaneous application of the cautery. For this purpose, L. Botalli invented a sort of guillotine, by means of which a member was severed from the body in an instant (*De Curandis Vulneribus Sclopetorum*. Lugd. 1560); while others laid a sharp axe upon the limb, and effected the dismemberment by the blow of a wooden mallet. This barbarous practice was once followed by Fabricius Hildanus, who is called by his countrymen the patriarch and ornament of German surgery, and who, previously to his acquaintance with the use of the ligature, was accustomed to amputate with a red-hot knife, the representation of which is given in his work. (*De Gangrænâ et Sphacelo, Op.*) Hildanus became a better surgeon, however, as he grew older, and, in the end, partly contributed to the improvement of amputation, inasmuch as he made the incisions completely in the sound parts, and adopted the method of tying the arteries, as then recently proposed by Paré; though in weak persons he still preferred the actual cautery to the ligature. (*Op.* p. 814.) One of his inventions was a linen bag, or cap, for the stump; and a sort of retractor for holding back the muscles.

By many surgeons, however, the tying of arteries continued to be deemed too troublesome, and hence they persisted in the barbarous use of the actual cautery: of this number were Pigrai (*Epitome des Préceptes de Méd. et de Chir.* 8vo. Rouen, 1642), F. Plazzoni (*De Vuln. Sclopet.* 4to. Venet. 1618), and P. M. Rossi (*Consult. et Observ.* 8vo. Francof. 16[illegible]6). Nay, so difficult was it to eradicate the blind attachment shown to the ancients, that Theodorus Baronius, a professor at Cremona, publicly declared, in 1609, that he would rather err with Galen, than follow the advice of any other person; and Van Hoorne seems even to have countenanced the detestable machine of Botalli. (Μικροτέχνη, p. 75.)

Ambrose Paré, who flourished in the 16th century (*Opera.* Parisiis, 1582), and to whom I have already alluded, made some beneficial innovations in the operation of amputation. It is to his industry, good sense, and skill, that we are chiefly indebted for the abolition of cauterizing instruments, and the general use of a needle and ligature for the suppression of the bleeding. (Lib. vi. c. 28. p. 224.)

An anonymous writer has given the following account of the practice and opinions of this distinguished surgeon in relation to amputation. "Paré recommended to cut off the whole of the gangrenous part, if the limb be mortified; but to encroach as little as possible upon the living flesh. At the same time he laid it down as a rule, not to leave a very long stump to an amputated leg; because the patient could more conveniently make use of a wooden leg, with the stump only five finger-breadths long below the knee, than if much more of the flesh were to be preserved. In the arm, however, he left the whole of the living and healthy portion of the member, only separating the diseased part from the sound.

"In preparing for amputation, he directs the skin and muscles to be drawn upwards, and bound tight with a broad bandage, a little above the part where the incision is to be made. This fillet was intended to answer a threefold purpose: 1st, To afford a quantity of flesh for covering the bone, and facilitating the cure. 2dly, To close the extremities of the divided blood-vessels. 3dly, To dull the patient's feelings, by pressure on the subjacent nerves. When this firm ligature has been applied, Paré directs an incision to be made down to the bone, either with a common scalpel, or a curved knife. Then, with a smaller curved knife, we are carefully to divide the muscles, or ligament, remaining between the bones of the forearm, or leg; after which, we may proceed to saw off the bone as high as possible, and to remove the asperities occasioned by the saw.

"With the assistance of a curved pair of forceps, he drew out the extremities of the bleeding arteries, either by themselves alone, or with some portion of the surrounding flesh, to be firmly tied with a strong double thread. He now loosened his bandage, brought together the lips of the wound over the face of the stump, and kept them as close as he could, without actual stretching, by means of four stitches, or sutures. If the larger tied vessels should accidentally become loose, he desires the ligature, or bandage, to be again passed round; or else, what is better, to let an assistant grasp the limb firm with both hands, and press with his fingers over the course of the bleeding vessel, so as to stop the hemorrhage; then, with a square-edged needle, about four inches long, and a thread four times doubled, the surgeon must secure the artery in the following manner:—Thrust the armed needle into the outside of the flesh, half a finger's breadth from the vessel which bleeds, and bring it out at the same distance from the bleeding orifice; then surround the vessel with the ligature, pass it back again to within one finger's breadth of the place where it first entered, and tie a fast knot upon a folded slip of linen rag, to prevent its hurting the flesh. By this means, says Paré, the orifice of the artery will be agglutinated to the adjoining flesh so firmly, as not to yield one drop of blood: but if the hemorrhage were not considerable, he contented himself with the application of astringent powders, &c.

"Thus did this famous surgeon endeavour, by his single example and precepts, to exclude the barbarous use of hot irons in amputation. He says, he knew not of any such practice among the old surgeons; except that Galen recommended us to tie bleeding vessels, towards their origin, in accidental wounds: and he thought proper to do the same in cases of amputation. But, in an apology, at the end of his book, Paré has quoted in his own defence a dozen authors, who employed or recommended the ligature before him; and he might have cited many more.

"From the statement we have here given, it may be seen how far the best writers of almost every country have erred in ascribing the original invention of tying arteries to Ambrose Paré. Great merit, indeed, was due to him, for the part he took in extending, and even reviving, this incomparable practice: nay, *it is not certain whether any one before him had ever applied the needle and ligature in similar cases*, i. e. *after amputation*: but how very wide of the truth Mr. John Bell's recent account of this matter is, will appear to every person who will inquire into the facts themselves; for not only were ligatures and needles in use among the ancients, but likewise the tenaculum, or hook, to lay hold of the bleeding vessels, when they had buried themselves in the muscles. We refer our inquisitive readers to Avicenna, Ætius, Albucasis, Brunus, Theodoric, Guido di Caulico, John de Vigo, L. Bertapælia, Tagaultius, Petrus Argillata, Andreas à Cruce, &c. &c., where they will find enough to satisfy them on this head." (*Rees's Cyclopædia*, art. *Amputation.*)

I shall not here expatiate upon the ill-treatment which Paré experienced from the base and ignorant Gourmelin; nor upon the slowness and reluctance with which the generality of surgeons renounced the cautery fot the ligature. These circumstances may be conceived from what has been already stated. Almost 100 years after Paré, a button of vitriol was ordinarily employed in the Hôtel Dieu at Paris for the stoppage of hemorrhage after amputations; and Dionis was the first French surgeon, who taught and recommended Paré's method. This happened towards the close of the 17th century, while Paré lived towards the end of the 16th. (*Dionis, Cours d' Opérat.* Paris, 1707.)

As Paré, like the rest of the old surgeons, used to cut directly down to the bone, many of the stumps, which he made, must have been badly covered with flesh, and ill fitted for bearing pressure. But all that I have read on the subject of amputation, impresses me with a strong conviction, that, in former times, the projection of the end of the bone, the sugar-loaf form of the stump, the frequent exfoliations, and the difficulty in healing the part, and keeping it healed, were as much owing to the mischief done with the cautery, the rude way of dressing the stump, and ignorance of the method of promoting union by the first intention, as to the mode of operating, or any other circumstance.

What, asks Brünninghausen, was the reason why the ligature of the arteries, which is now regarded by the surgeons of all civilized nations as the best, easiest, and safest method of stopping hemorrhage after amputation, should so long have remained unadopted? Besides the prejudice for the opinions of the ancients, already mentioned, another cause was, undoubtedly, the imperfect knowledge of the circulation of the blood,—a correct description of which was first delivered by the immortal Harvey early in the 17th century. (*Exercitatio Anat. de Motu Cordis et Sanguinis in Animalibus.* Francof. 1628.) For some time, this grand discovery met with violent opposition; but, after it had been acknowledged as an eternal truth, a happy application of it was made to surgery by a French surgeon, named Morell, who, at the siege of Besançon, in 1674, invented the field tourniquet, by means of which more certain pressure was made on the trunk of the artery. By this simple invention, founded, however, on a knowledge of the circulation, the surgeon could at option let the blood of the stump spirt out, or stop its jet entirely; and now, both during and after the operation, he was first enabled to command the hemorrhage, and coolly and judiciously employ whatever measures were indicated; for the most powerful bandages and pressure, previously in use, either stopped the circulation in the whole limb, or could not be made to have the right effect with sufficient quickness. (*Brünninghausen, Erfahr. &c. über die Amp.* p. 36.) Morell's tourniquet, however, was very imperfect; and it was not till the year 1718, that J. L. Petit, whose name shines so brightly in the history of surgery, invented the kind of tourniquet now employed.

Richard Wiseman, who is justly considered as the father of good English surgery, saw the necessity of making the incision in the sound parts, because gangrene does not always spread evenly, but frequently extends much higher up one side of the limb than the other. He deemed the actual cautery objectionable, as the sloughs were so long in being thrown off. He applied a ligature round the limb, two inches above the limits of the mortification, and, drawing up the muscles, made the incision with a large curved knife, with the back of which he scraped off the periosteum. The bag, or sort of retractor, employed by Fabricius Hildanus, Wiseman thought unnecessary, as the muscles spontaneously drew themselves up as soon as divided. He tied the blood-vessels after the manner of Paré, and deprecated all burning of the stump. After the operation, he drew the flaps over the bone, and either fastened them in this position with stitches, or a tight bandage; though he generally preferred the former, as the surest means of keeping the end of the bone from protruding. Across the stump he laid a pledget of wax-cerate, and over this a thick layer of Armenian bole and other styptics, and the whole was covered with a bullock's bladder, and a roller, applied spirally from the upper part of the remaining portion of the limb, down to the extremity of the stump. On the third day, the dressings were taken off, and a digestive ointment applied. (*Chirurg. Treatises*, vol. ii. p. 220. 8vo. Lond. 1690.)

From this time, amputation may be considered as being an infinitely safer proceeding than what it used to be; for, as we have explained, the ligature of the arteries was now practised and commended in Germany by F. Hildanus, in England by Wiseman, and in France by Dionis. Much, however, remained to be done. The wound was large, and suppurated long and profusely; the healing was slow; the ends of the bones perished, and, projecting far beyond the soft parts, retarded the cure so long, that the patient was not unfrequently worn out. Hence the best surgeons began seriously to consider what further could be done, with a view of lessening the exposed surface of the wound, and making a better covering of flesh for the ends of the bones.

According to Sprengel, most of the old surgeons preserved a flap of flesh, and he is therefore by no means disposed to regard our countryman Lowdham as the inventor of this method, though it is acknowledged that the latter surgeon's practice was novel, inasmuch as the flap was formed by making an oblique incision through the integuments from below upwards. (See *James Yonge's Currus Triumphalis e Terebintho*, 8vo. Lond. 1679; and *Sprengel's Geschichte der Chirurgie*, b. i. p. 408.) Here, if Sprengel means that many of the old surgeons endeavoured to preserve a partial covering of flesh for the bone, there can be no doubt of its correctness, because we find that they drew back the flesh before they divided it; and Celsus and some others even did more; for, after cutting down to the bone, they detached the flesh further from it upwards, previously to taking the saw: but, on the contrary, if Sprengel wishes us to believe that there were practitioners, who, previously to Lowdham, in the operation of amputation, formed what in England is usually understood by a flap, — that is, a portion of flesh, generally of a semilunar shape, and saved from one side, or both, of the member, for covering the bone, — I cannot see any reason for coinciding with Sprengel's observation. Upon the merit of Lowdham's suggestions, and the practice and principles inculcated by J. Yonge, some reflections, communicated to me by Mr. Carwardine, I insert with great pleasure, as perhaps he is right in thinking that some former editions of this work did not do justice to the memory of the latter writer.

"At the time Yonge wrote (1679)," says Mr. Carwardine, "it was supposed impossible to heal a stump before the bone had exfoliated, and, therefore, no surgeon would venture upon an attempt at uniting the surface by the first intention. Now, this union by the first intention *was the chief object* of Mr. Yonge in proposing the flap-operation; and it is to him, and not to Mr. Alanson, who wrote precisely 100 years after him, that we must attribute the honour of this improvement. It is related in a letter addressed to his friend Thomas Hobs, chirurgeon, in London, dated Plymouth, August 3. 1678, and published 1679, at the end of his Currus Triumphalis e Terebintho. It begins thus: —

"'Sir, I find by your's that you are surprised with the intimation I gave you, of a way of amputating large members, so as to be able to cure them *per symphysin* in *three weeks*; and without fouling or scaling the bone. It is a paradox which I will now evince to you to be a truth, after I have first taken notice of what you affirm, that there is a necessity of scaling the ends of those bones left bare after the usual manner of dismembering, before the stump can be soundly cured; that you never yet found it otherwise, but that, where it hath been attempted, the stumps have apostumated, and the caries come off thereby.'

"Yonge then acknowledges, that it was from an ingenious brother, Mr. C. Lowdham, of Exeter, that he had the first hint thereof. He then describes the operation — the laying down the flap over the face of the stump, and sewing it by four or five stitches, &c. After this Yonge proceeds with a methodical enumeration of the advantages of this mode of operating over all others then in use, viz. that it is more *speedy* — the cure not occupying *a fourth of the usual time* — *no suppuration* — *no exfoliation* — less danger of hemorrhage — not liable to break open again from slight injury — and, lastly, much better adapted to the pressure from an artificial leg, &c.

The foregoing abstract will show (says Mr. Carwardine) how far Mr. O'Halloran's method, in which he dresses the flap and the stump as distinct surfaces, can be regarded as a revival of Lowdham's operation, or whether it has been superseded or improved upon by the *mechanical* ingenuity of the Dutch and French surgeons: — The apparatus of M. de la Faye and Verduin appear to have been merely clumsy and unscientific contrivances for the suppression of hemorrhage. Garengeot's operation had also for its object, to supersede the use of the ligature, which, however, after twelve years' practice, he was obliged to give up, and tie the vessels before he laid down the flap. Opinions therefore founded upon the practice of these gentlemen, I conceive cannot fairly be admitted as evidence against the flap-operation of Lowdham, which nevertheless appears sinking in the estimation of the best modern surgeons: perhaps no material advantage is gained by it over the common mode of operating in the *lower extremities*, as now practised — but even here, cases may occur where we are glad to resort to it: a few years since, I attended a patient in consultation with a friend at Dunmow, in Essex, where we thought it necessary to remove a man's leg for a caries of the tibia. An ulceration in front extended so high, that no integument could be saved, and the limb would have been removed above the knee, if I had not suggested the propriety of making a flap from the calf of the leg. The tibia was obliged to be sawn as high as possible, but the flap was left sufficiently long to cover the surface, and that most important object, the bend of the knee, was preserved to bear the pressure of a wooden leg. In the removal of the arm at the shoulder-joint, doubtless the advantages of making a flap from the deltoid, &c., are sufficiently established; but, in the mode of dressing, I presume that no English surgeon will admit, that the practice of M. Larrey (perhaps the most eminent surgeon that has been formed by the wars of Bonaparte, and whose practice will be hereafter noticed) can supersede the method of Yonge (or Lowdham), who wrote 140 years before him! Larrey introduces charpie beneath the flap to *prevent* union by the first intention! Lowdham's object is simply to lay the flap over the wound to prevent exfoliation, and to heal the surface '*per symphysin*' in three weeks." After the receipt to this communication, I looked over the copy of the Currus Triumphalis e Terebintho, preserved in the valuable library of the Royal Medical and Chirurgical Society, and found Mr. Carwardine's statement fully confirmed by the contents of that ancient work. At the same time, I retain the belief, that the example set by Mr. Alanson, with respect to the proper method of dressing stumps, and obtaining a speedy union of the wound, is entitled to the praise of posterity, because his advice was so well enforced that it soon produced a revolution in practice; while the correct suggestions of Lowdham and Yonge, like the hint in Celsus, of the double incision, had sunk into oblivion, or were only known to a few admirers of surgical antiquities.

Mauquest de la Mothe was one of the first who commonly used the tourniquet in amputations, afterwards drawing out the vessels with the forceps and tying them. (*Traité compl. de Chir.* vol. iii. p. 171.) Lowdham's original suggestion of amputating with a flap has been briefly noticed. About 18 years after Yonge's publication, Peter Verdiun, an eminent surgeon at Amsterdam, submitted to the judgment of the profession a new kind of flap-amputation. (See *Dis. Epistolica de Novâ Artuum decurandorum Ratione*, 8vo. Amst. 1696.) Two compresses were applied, one under the ham, and the other on the course of the large vessels. The thigh was wrapped in a fine linen cloth, which was sustained by some turns of a roller. This apparatus was covered with a piece of leather, six inches broad, furnished with three straps with buckles, to secure it round the part. The tourniquet was placed in the usual manner. The part, above the place intended to be amputated, was surrounded with a leather strap. The point of a crooked knife, which was made to pass as near to the back part of the bones as possible, was thrust in on one side of the leg, and made to come out on the other. The knife was then carried down, and a flap made of almost the whole calf of the leg. The operation was finished in the ordinary manner. The wound was then washed with a wet sponge, in order to clear it from the fragments of sawn bone. The leather strap, which served to secure the flesh, was next loosened, and the flap laid over the stump. The wound was dressed with lycoperdon, lint, and tow, over which was put a bladder, sustained by strips of sticking-plaster. Upon this bladder was placed an instrument, called a *retinaculum*, consisting of a compress, and a concave plate, which were made to press upon the stump, by means of two straps, which crossed each other, and were attached to the broad leather strap surrounding the thigh.

Some excellent precepts on amputation were delivered by J. L. Petit He improved the tourniquet; and instead of the large crooked amputating knife, formerly employed, first brought into use the straight, more moderate-sized knives with sharp backs, now seen in the hands of the best surgeons, because much better calculated than crooked knives for dividing the flesh by a sawing movement, which is the only right and surgical way of attempting to cut any part of the human body. He proved that making the division in the mortified parts was frequently followed by hemorrhage; and for the suppression of bleeding, he thought it the best principle to promote the formation of a coagulum. (*Mem. de l'Acad. des Sciences*, an. 1732, p. 285. See Hemorrhage.) For compressing the vessels, he employed an instrument which covered the stump, like Verduin's retinaculum, and made pressure by means of a screw. His only objection to Verduin's method was, that the extension of gangrene up the limb frequently hindered the formation of so large a flap. He laid down the valuable general maxim of always removing as much bone, and as little flesh, as possible; for which purpose, he invented what is termed the *double incision*, or dividing the business of cutting through the soft parts into two stages. At some distance below the place where he meant to saw through the bones, he first made the circular cut through the integuments down to the muscles; the skin was then pulled up so as to leave the flesh uncovered to the extent of an inch, and the muscles were now divided at the highest point of their exposure. Lastly, the flesh was held out of the way with a retractor, and the bone was sawn through high enough up to allow of its extremity being well covered with flesh and integuments. The greatest defect in the doctrines of Petit, relative to amputation, was the confidence he put in pressure, instead of the ligature. (*Traité des Malad. Chir.* vol. iii. p. 126.)

The first performance of amputation at the shoulder joint, by Le Dran, and the improvements and alterations of that operation suggested by Garengot, De La Faye, Desault, Larrey, &c., I shall notice in a future section.

Verduin, in his method, formed only one flap. Ravaton and Vermale afterwards thought that it would be better to save a flap from each side of the limb. They were also advocates for tying the vessels, and bringing the two flaps into contact, so as to procure their speedy union, and hinder exfoliations and profuse suppuration. Vermale, after applying the tourniquet, surrounded the part with two red threads, at the distance of four fingerbreadths from each other; one at the place where the bone was to be sawn, the other at the place where the incision of the flaps was to terminate. He afterwards thrust a long bistoury down to the bone, at the fore part of the limb; turned it round the circumference, so that it might come out at the opposite part; then, directing the edge of the knife along the bone, he cut down to the inferior thread, where he completed the first flap, which, as the author says, was of a round or conical figure at its extremity. The second flap was made in a similar way on the interior side of the member. This method is essentially the same as what is often practised at the present time on the thigh and arms. (*Traité des Playes d'Armes à feu, par Ravaton*, 8vo. Paris, 1750; *De la Faye, in Mém. de l'Acad. de Chir.* t. v. ed. 12mo.; *Vermale, Obs. de Chir.* 8vo. Manheim, 1767.)

The multiplicity of machines, described by Verduin, La Faye, &c., had no other end but that of keeping the flap near the orifices of the vessels, so as to compress and close them. In consequence of the difficulty of making this compression precisely as required, the most considerable vessels between the two bones, when cut, generally becoming retracted, Garengeot determined to employ ligatures.

His first operation of this kind was an amputation of the arm with two flaps. The brachial artery was tied, and the patient cured without any exfoliations.

Garengeot operated also on a soldier dangerously wounded in the right foot by the bursting of a bomb, which fractured the interior part of the two bones of the leg, and several of the foot: the patient recovered in twenty-seven days. A single flap was made. He rightly preferred dressing and bandaging the stump to the use of the compressing machines invented by Verduin and La Faye; and his choice of a straight knife, instead of a crooked one, was equally judicious.

The preceding case dictated a truth, which will last as long as surgery itself, viz. *that it is advantageous to apply the ligatures in such a manner as to embrace no more than the vessel, so that they may fall off the sooner, and the parts more quickly unite.* (*Garengeot, in Mém. de l'Acad. de Chir.* t. v. 12mo.)

At one time, an objection frequently urged against the foregoing methods, was, that, when the fresh cut flap was immediately laid over the stump, inflammation and abscesses were apt to ensue. Hence, in 1765, Sylvester O'Halloran, a surgeon at Limerick, was led to make the experiment of deferring laying down the flap till the end of the first eight or twelve days after the operation, when it was conjectured that the risk of inflammation and abscesses would be diminished. The tenor of O'Halloran's book is apparently corroborated by the facts brought forward. Here we see one of the grand points insisted upon by our worthy countryman James Yonge, viz. the chance of an immediate union of the wound from laying down the flap without delay, suddenly given up, and because the wound could not always be healed without suppuration, it was determined that it never should do so.

Alexander Monro, senior, disapproved of the tourniquet; he secured the vessels with needles and ligatures; and was the inventor of a bandage, which has been extensively approved of, under the name of Monro's roller. (*Medical Essays of Edinb.* vol. iv. p. 257.)

Bromfield, like Le Dran, restricted amputation to a few cases; and he did not acknowledge its necessity, as a matter of course, in every case of gangrene, much less in every instance of white swelling, or caries. From a passage, which I have cited from Dr. Rees's Cyclopædia, it would seem that the tenaculum was known to the ancients; but Bromfield is allowed to be the first modern surgeon who employed this useful instrument. (*Chir. Cases and Obs.* vol. i. p. 41. 8vo. Lond. 1773.)

About the year 1742, the removal of thighs without bloodshed was a subject a good deal broached. A single case, recorded by Schaarschmid, where a mortified thigh separated without hemorrhage, was the foundation of the scheme. The arteries were completely blocked up, and the parts insensible. (*Haller, Dis. Chir.* vol. v. p. 155.) A similar occurrence was related by Acrel (*Chir. Händels*, p. 557.); and Lalouette professed himself a believer in the security from hemorrhage, on account of the vessels being filled with coagula, and therefore he also approved of letting dead parts be removed, or rather fall off, without bloodshed. (*Haller, Dis. Chir.* vol. v. p. 273.)

In cases where the projecting bone of the stump was affected with necrosis, Bagieu ventured to amputate a second time, and urged a variety of arguments in defence of the practice. (*Mém. de l'Acad. de Chir.* t. ii. p. 274.) He coincided with Le Dran and Bromfield, however, about the propriety of restricting amputation to few cases; and has related numerous examples of limbs being saved, which, according to the doctrines then in vogue, ought to have been cut off. (*Deux Lettres d'un Chir. de l'Armée*, 12mo. Paris, 1750.)

M. Louis, a French surgeon of extraordinary talents, introduced the plan of dividing the loose muscles first; and lastly, those which are closely connected with the bone. He noticed, that the muscles of the thigh, after being divided, were retracted in an unequal degree. He observed, that the superficial ones extending along the limb, more or less obliquely, without being attached to the bone, were drawn up with greater force, and in a greater degree, than others, which are deeply situated, in some measure parallel to the axis of the femur, and fixed to this bone throughout their whole length. The retraction begins the very instant when the muscles are cut, and is not completed till a short time has elapsed. Hence the effect should be promoted, and be as perfect as possible, before the bone is sawn. In amputation of the thigh, M. Louis was always desirous of letting the muscles contract as far as they could; and, for this reason, he was rather averse to using the tourniquet, as the circular pressure of this instrument in some measure counteracted what he wished to take place, and hence, at one time, he preferred letting an assistant make pressure on the artery; though he subsequently expressed his approbation of the tourniquet proposed by M. Pipelet for compressing the femoral artery. (*Mém. de l'Acad. de Chir.* vol. iv. p. 60. 4to.) Actuated by such principles, Louis practised a kind of double incision different from that of Cheselden and Petit, and different also from Alanson's method, which I shall hereafter notice. By the first stroke, he cut, at the same time, both the integuments and the loose superficial muscles; by the second he divided those muscles which are deep, and closely adherent to the femur. On the first, deep, circular cut being completed, Louis used to remove a band, which was placed round the limb, above the track of the knife. This was taken off, in order to allow the divided muscles to become retracted without any impediment. He next cut the deep adherent muscles, on a level with the surfaces of those loose ones, which had been divided in the first incision, and which had now attained their utmost state of retraction. In this way, he could evidently saw the bone high up, and the painful dissection of the skin from the muscles was avoided. Louis was conscious that there was more necessity for saving muscle than skin; and he knew that, when an incision was made at once down to the bone, the retraction of the divided muscles always left the edge of the skin projecting a considerable way beyond them. Hence he deemed the plan of first saving a portion of skin, by dissecting it from the muscles, and turning it up, quite unnecessary. As the bone should always be sawn rather higher than the division of the soft parts, Louis, like J. L. Petit, and most other judicious surgeons, highly approved of the employment of a retractor. He was likewise the author of some valuable instructions for preventing the protrusion of the bone after the operation. (See *Mém. de l'Acad. de Chir.* t. ii. p. 268—410, &c. 4to.) The impartial reader, who takes the trouble to read the remarks on amputation, published by this greatest of all the French surgeons of the last century, with the exception perhaps of J. L. Petit and Desault, will be impressed at once with the force and perspicuity of his matter, and with the evident propriety of a good deal of the practice inculcated. Dupuytren often followed the maxim of dividing the skin and loose superficial muscles together.

In England, Cheselden, and not J. L. Petit, is regarded as the surgeon who revived Celsus's method, by having recourse to *a double incision*—that is, by cutting the skin and cellular substance first, and then, by dividing the muscles down to the bone, on a level with the edge of the skin, so that the bone might be sawn higher up, and its end be more completely covered with skin. Whether Cheselden had the priority in this improvement, I cannot presume to say; but he gave an account of it in Gataker's translation of Le Dran's treatise on the operations as early as 1749, which was long prior to the appearance of Petit's posthumous writings; and Cheselden further mentions, that, during his apprenticeship to Mr. Fern, he had communicated to that gentleman his sentiments about the double incision.

In order to hinder the stump from assuming a pyramidal, or sugar-loaf shape, which sometimes happened, notwithstanding every improvement hitherto mentioned, a circular bandage was employed, which acted by supporting the skin and muscles, and preventing their retraction. This bandage, when properly applied, from the upper part of the limb downward, fulfilled in a certain measure the end proposed, though many stumps yet turned out very bad ones. Mr. Sharp was induced, therefore, to revive the ancient plan of bringing the edges of the skin together with sutures; but the pain and other inconveniences of this method were such, that it was never extensively adopted, and Mr. Sharp himself ultimately abandoned it. The cross bandage, however, which he used to put over the end of the stump, remains partially in fashion even at the present day. (*Treatise on the Oper.* p. 216.; *Critical Inquiry*, p. 268.) It is to be regretted, that an excellent modern surgeon, the late Mr. Hey, should have commended, so strongly as he has done, the use of sutures, in bringing together the edges of the wound after amputation. (*Practical Obs. in Surgery*, p. 534. edit. 2.)

The inefficiency of the method of Louis for hindering the protrusion of the bone was asserted by Valentin, who thought the object might be better attained by dividing the parts while they were in a state of tension; for which purpose he recommended changing the posture of the limb, according to the parts which he was about to cut. (*Recherches Critiques sur la Chirurgie Moderne*, 8vo. Amst. 1772.) Valentin's proposal seems never to have excited much attention; whether on account of its inconvenience, or inefficacy, I know not: certain it is, many cases present themselves, in which the posture of a limb absolutely cannot be changed during the operation, owing to the nature of the disease, or cannot be altered without extreme agony.

About the middle of the eighteenth century, arose the celebrated controversy about the propriety of amputation in general. Several surgeons now began to be convinced, with Le Dran and Bagieu, that the operation was undertaken on too light grounds; and, in particular, that many bad complicated fractures might be cured without amputation. Such was the doctrine of Boucher (*Mém. de l'Acad. de Chir.* t. ii. p. 304.), Gervaise *Anfangsgr. der Wundarzn.* 8vo. Strasb. 1755), and Faure (*Mém. qui ont concoura pour le Prix de l'Acad. de Chir.* vol. i. p. 100.). The latter, especially, urged the prudence of delay, in gunshot wounds, and comminuted injuries of the bones. But the writer who at this time made the greatest noise in the world, by his general condemnation of amputation, was Bilguer (*Diss. de Membrorum Amputatione*, 8vo. Hal. 1761), whose sentiments received, however, a complete refutation from his own contemporaries, Pott (*Chir. Works*, vol. ii.), Morand (*Opusc. de Chir.* t. i. p. 232.), and De la Martinère (*Mém. de l'Acad. de Chir.* vol. iv. p. 1.), and also from later writers, to whom reference will be made in speaking of *Gunshot Wounds*. Even Bilguer himself was compelled to admit the necessity of amputation in cases of gangrene. (*Anweis. für die Feldwundärzen*, s. 170.)

Bilguer's colleague, the celebrated Schmucker, inclined to the same doctrines, and has detailed several cases, where limbs were not only shattered, but actually carried away by balls, yet where a cure followed without amputation. One of his maxims was, that it was better for the member to be taken off by gunshot, than by the surgeon's knife, as the ball operated on a healthy subject, the knife on a person debilitated by an hospital. (*Chir. Wahrn.* th. ii. s. 493.) In a later valuable essay on this subject, he restricts amputation to shattered limbs, affected with gangrene. His mode of operating was that of M. Louis. He sanctioned joint-operations at the hip and shoulder; but condemned those of the knee and elbow, as never answering. (*Verm. Schrift.* th. i. s. 3.)

Soon after the middle of the last century, the practice of amputating at the joints began to excite increased attention; but, as this is a topic to which I must presently return, it is unnecessary now to dwell upon it. The writings of Puthod, Wohler, Brasdor, Barbet, Sabatier, Park, Moreau, and Vermandois, in relation to this subject, deserve particular notice.

In now come to Mr. Alanson, whose name is as conspicuous in the history of amputation as that of any surgeon yet mentioned. His chief objects were to hinder a protrusion of the bone, and promote union by the first intention. He rejected the band, which was formerly put round the limb for the guidance of the knife, as altogether useless, and an impediment to the quick performance of the circular incision through the skin. When the tourniquet had been applied, an assistant grasped the integuments with both hands, and drew them and the muscles firmly upwards. The operator then fixed his eye upon the proper part where he was to begin the incision, which was made with considerable facility and dispatch, the knife passing with greater quickness in consequence of the tense state of the integuments.

After the incision through the skin had been made, the assistant still continued a steady support of the parts, while Mr. Alanson separated the cellular and ligamentous attachments with the point of his knife, till as much skin had been drawn up as would, with the muscles, divided in the particular way hereafter recommended, fully cover the whole surface of the wound. Then, instead of applying the knife close to the edge of the integuments, and dividing the muscles in a circular perpendicular manner down to the bone, Mr. Alanson proceeded as follows: — When operating upon the thigh, and standing on the outside of the limb, he applied the edge of his knife under the edge of the supported integuments, upon the inner margin of the vastus internus muscle, and cut obliquely through that and the adjacent muscles, upwards as to the limb and down to the bone, so as to lay it bare about three or four finger-breadths higher than is usually done by the common perpendicular circular incision. He now drew the knife towards himself; then keeping its point upon the bone, and the edge in the same oblique line already pointed out for the former incision, he divided the rest of the muscles in that direction all round the limb; the point of the knife being in contact with, and revolving round the bone through the whole of the division.

According to Mr. Alanson, the speedy execution of the above-directed incision will be much expedited by one assistant continuing a firm and steady elevation of the parts, and another taking care to keep the skin from being wounded, as the knife goes through the muscles, at the under part of the limb. Mr. Alanson censures the old method of depriving the bone of its periosteum to a considerable extent, above and below the part where the saw is to pass, not only as creating unnecessary delay, but, since the periosteum serves to support the vessels in their passage to the bone, as apt to produce exfoliations above the part where the bone is to be divided with the saw. Instead of this practice, he recommends first the application of the retractor, as advised by Gooch and Bromfield; and then denuding the bone at the part where the saw is to pass, whereby the bone may be sawn off higher than is usually practised; a material object in hindering a projection of the bone, and forming a small cicatrix.

If the flesh of a stump, formed in the thigh, agreeably to the foregoing plan, be gently brought forward after the operation, and the surface of the wound be then viewed, it may be said to resemble in some degree a conical cavity, the apex of which is the extremity of the bone; and the parts, thus divided, Mr. Alanson thought the best calculated to prevent a sugar-loaf stump.

The part where the bone is to be laid bare, whether two, three, or four finger-breadths higher than the edge of the retracted integuments; or, in other words, the quantity of muscular substance to be taken out, in making the double incision; must be regulated by considering the length of the limb, and the quantity of skin that has been previously saved by dividing the membranous attachments. The quantity of skin saved, and muscular substance taken out, must be in such exact proportion to each other, that the whole surface of the wound will afterwards be easily covered, and the limb not more shortened than is necessary to obtain this end.

After the removal of the limb, Mr. Alanson drew each bleeding artery gently out with the tenaculum, and tied it as nakedly as possible, with a common slender ligature. When the large vessels had been tied, the tourniquet was immediately slackened, and the wound well cleaned, in order to detect any vessel, that might otherwise have remained concealed with its orifice blocked up with coagulated blood; and before the wound was dressed, its whole surface was examined with the greatest accuracy; by which means Mr. Alanson frequently observed a pulsation, where no hemorrhage previously appeared, and turned out a small clot of blood from within the orifice of a considerable artery. He is very particular in recommending every vessel to be secured that is likely to bleed on the attack of the symptomatic fever; for, besides the fatigue and pain, to which such an accident immediately exposes the patient, it seriously interrupts the desired union of the wound. He used always to cleanse the whole surface of the wound well with a sponge and warm water, as he rightly thought that the lodgment of any coagulated blood would be a considerable obstruction to the quick union of the parts.

The skin and muscles were now gently brought forwards; a flannel roller was put around the body, and carried two or three times rather tightly round the upper part of the thigh, as at this point it was intended to form what Mr. Alanson called a sufficient basis, which materially added to the support of the skin and muscles. The roller was then carried down in a circular direction to the extremity of the stump, not so tight as to press rudely or forcibly, but so as to give an easy support to the parts.

She skin and muscles were now placed over the bone in such a direction that the wound appeared only as a line across the face of the stump, with the angles at each side; from which points the ligatures were left out, as their vicinity to either angle might direct. The skin was easily secured in this posture by long slips of linen or lint of the breadth of about two fingers, spread with cerate, or any cooling ointment. If the skin did not easily meet, strips of sticking-plaster were preferred. These were applied from below upwards, across the face of the stump, and over them a soft tow-pledget and compress of linen; the whole being retained with the many-tailed bandage, and two tails placed perpendicularly, in order to retain the dressings upon the face of the stump.

Mr. Alanson censured the plan of raising the end of the stump far from the surface of the bed with pillows, as the posterior muscles were retracted by it; and he considered it best to raise the stump only about a half hand's breadth from the surface of the bed, by which means the muscles were put in an easy relaxed position. The many-tailed bandage Mr. Alanson found much more convenient than the woollen cap, frequently used in former times to support the dressings: and he observes, that, though this seems well calculated to answer that purpose, yet, if be not put on with particular care, the skin is liable to be drawn backwards from the face of the stump; nor can the wound be dressed without first lifting up the stump to remove the cap. (See *Alanson's Practical Obs. on Amputation*, 8vo. Lond. 1779.)

The chief peculiarity in Alanson's method of operating, namely, the mode in which he recommends the oblique division of the muscles to be performed, did not, however, meet with universal approbation; and his extensive dissection of the skin from the muscles was complained of, as excessively painful. The formation of a conical wound, by following Alanson's directions, was regarded by several as impracticable. (See *Marten's Paradoxieen*, b. i. s. 88.; *Loeffler, Beytrage*, i. No. 7.; *Wardenburg. Briefe eines Arztes*, 2 b. p. 20.; *Richter, Anfangsgr.* vol. vii.; *Graefe, Normen*, *&c.* p. 8.; *Hey, Pract. Obs.*) In my opinion, there can be no doubt of the truth of some of the criticisms made by these, and some other writers, on the impossibility of making a wound, with a regular conical cavity, by observing the directions given by Alanson; for if the knife be carried round the member with its edge turned obliquely upwards towards the bone, it will pass spirally, and, of course, the end of the incision will be considerably higher than the beginning. But, though Alanson probably never did himself exactly what he has stated, I am sure that his proposition of making an oblique division of the muscles all round the member has been the source of great improvement in amputations in general. It is true that surgeons do not actually perform the oblique incision all round the limb by one stroke, or revolution of the knife round the bone, as Alanson says that he did; but they accomplish their purpose by repeated, distinct, and suitable applications of the edge of the instrument turned obliquely upwards towards the bone, or bones.

Amongst others, Mynors found fault with some of Alanson's instructions, and thought every desideratum might be more certainly attained by saving skin enough, and then cutting through the muscles. The first incision, however, he directed obliquely upwards through the integuments, while they were drawn up by an assistant, and he then cut down to the bone. (*Pract. Thoughts on Amputation*, 8vo. Birming. 1783.)

The removal of limbs without bloodshed, proposed by Guido di Cauliaco in the 14th century, met with modern defenders in J. Wrabetz and W. G. Plouquet. J. Wrabetz, with a ligature which was daily made tighter, took off an arm above the elbow. Into the fissure he sprinkled a styptic powder. On the fourth day the flesh was severed down to the bone, which was sawn through. (*Geschichte eines ohne Messer abgesetzen Oberarms*, 8vo. Freyb. 1782.) Plouquet thought the plan suited to emaciated timid subjects; but not well adapted to the leg or fore-arm. (*Von der Unblütigen Abnehmung der Glieder*, 8vo. Tub. 1786.) The only exemplification of the practice of taking off limbs without bloodshed in modern practice, is sometimes afforded in chronic mortification, where, after the separation of the dead from the living parts down to the bone by Nature herself, the surgeon saws through the exposed bone. In the North London Hospital, an upper extremity, attacked with chronic mortification, was thus removed by Mr. Liston, a little below the axilla, and the patient, a very old woman, recovered.

Some modes of performing flap-amputations, and, in particular, the suggestions and improvements made by Hey, Chopart, Dupuytren, Larrey, Lisfranc, Liston, and other modern practitioners, will be noticed in the description of the amputation of particular members. In the mean time, I shall conclude this section with mentioning the laudable attempts, made at different periods, to render the patient less sensible of the agony produced by the removal of a limb. Theodoricus administered for this purpose opium and hemlock, and, though he was imitated by many of the ancient surgeons, few moderns have deemed the practice worthy of being continued. The inhalation of stupefying gas has been tried, and so has magnetism. M. J. Cloquet, by some preparatory means not specified by Velpeau, brought a patient into a condition in which the removal of the breast was accomplished without her having been aware of it. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 297.) Guido made the experiment of benumbing the parts with a tight ligature; but a machine, devised a few years ago in England, expressly for the object of stupefying the nerves of a limb previously to amputation, seems freer from danger than some of the means adopted to bring the patient into a stupefied state. (See *J. Moore's Method of preventing or diminishing Pain in several Operations of Surgery*, 8vo. Lond. 1784.) The great reason of the latter plan being given up is, that some patients have made more complaint of the sufferings occasioned by the process of dulling the sensibility of the nerves, than of the agony of amputation itself, without any such expedient. Yet daily experience proves that the pressure, caused on the sciatic nerve by sitting with the pelvis in a certain position, will completely benumb the foot and leg, and this with such an absence of pain, that the person so affected is actually unaware of his foot *being asleep*, as it is termed, until he tries to walk.

AMPUTATION OF THE THIGH.

The thigh ought always to be amputated as low as the disease will allow; so that as little of the limb may be cut off as possible, the pain may not be greater than necessary, the surface of the wound have less extent than would otherwise happen, and the preserved portion of the limb greater power in proportion to its length. The longer it is, the better also will it be adapted to any artificial means to enable the patient to walk. (*Sabatier, Med. Obs.* p. 350. t. iii. ed. 2.) The patient is to be placed on a firm table, with his back properly supported by pillows and assistants, who are also to hold his hands, and keep him from moving too much during the operation. The ankle of the sound limb may be fastened, by means of a strong band or garter, to the nearest leg of the table.

Here, however, through an imprudent solicitude to obtain the above advantages, let not the surgeon ever be unmindful of the great axiom in surgical operations, that all the diseased parts should be removed; and let him be assured of the truth of what Graefe inculcates, that it is more pardonable to cut away too much than too little. (*Normen für die Absösung grösserer Gliedm.* p. 60.) At the same time, I do not agree with some modern writers, who deem it necessary to amputate beyond the limits of every abscess and sinus which may extend very far above a diseased joint or compound fracture. Many of these suppurations are only like ordinary abscesses, and finally get well, after the main disease or injury is removed, as I have often seen. Were it an invariable rule to cut off a limb above every collection of matter, sometimes five or six inches more of the thigh would be sacrificed than circumstances absolutely demanded, and the greater danger of a high, than a low operation, would be encountered. However, in all cases where the bone is suspected to be unsound, or the muscles are affected with the morbid changes peculiar to fungus hæmatodes or other incurable diseases, the operation should be practised sufficiently high to take away all the distempered parts. In secondary amputations, where there has been much suppuration in the limb, and a sinus runs up, Mr. Guthrie says, that if the sinus extend only a short way between the muscles, the membrane lining it may be dissected out; but, if the matter has lain upon the bone, this will have become diseased, and amputation should be practised high enough to remove the affected part of it. (*On Gunshot Wounds*, p. 87.)

Many writers disapprove of amputating too close to the knee (*Graefe*, *Op.* cit. p. 60.); and Langenbeck urges one objection to it, not specified by any other author, viz. that, if the operation be done lower down than two hand-breadths above the knee, the femoral artery shrinks into the aponeurotic sheath, which it here receives from the vastus internus and triceps, and cannot be drawn out with the forceps, so as to be separately tied, without first slitting up that sheath. Hence, he recommends cutting through the muscles at the distance above the knee already mentioned. (*Bibl. für die Chir.* b. i. p. 571. 12mo. Gott. 1806.) But, when I come to look at the breadth of two adult hands, and see how much of the limb would be sacrificed, at all events, only to save a little trouble, I cannot bring my mind to concur with Langenbeck, — the remedy being worse than the alleged evil. In general, the disease obliges the surgeon to begin the incisions two or three inches above the patella, and, as Velpeau remarks, Langenbeck's direction is superfluous. (*Nouv. Elém. de Méd. Opér.* t. i. 504.)

The next thing is the application of the tourniquet. (See Tourniquet.) The pad should be placed exactly over the femoral artery, in as high a situation as can be conveniently done. When the thigh is to be amputated high up, it is better to let an assistant compress the femoral artery in the groin with his thumb, or any commodious instrument, furnished with a round blunt end, calculated for making direct pressure on the vessel without injuring the integuments. Some authors, indeed, give a general preference to this method, whether the thigh be amputated high up or low down. (*Paroisse, Opuscules de Chir.* p.188.; *Brünninghausen, Erfahr. über die Amp.* p. 273.; *Langenbeck, Bibl. Chir.* p. 564.; *Liston, Obs. in Ed. Med. and Surg. Journ.* vol. xx. p.43., and *Elements*, part iii. p. 362.) Were the patient, however, in a debilitated state, and unable to bear loss of blood, as there might, in this way, be considerable bleeding, by reason of the anastomoses with the branches of the internal iliac artery, I should feel disposed to employ the tourniquet whenever circumstances would conveniently admit of its application. In amputations of the thigh, the great objection to the use of this instrument is, that it impedes the free and immediate retraction of the loose muscles after they have been cut; the consequence of which is, that the surgeon cannot divide so high, as he otherwise could do, the deeper muscles, which are more fixed and attached to the bone. Yet, in order to have the bone well covered with flesh, and no danger of a sugar-loaf stump, the latter object is one of vast importance. Perhaps the best general rule is, to abandon the application of the tourniquet in amputations performed as high as the middle of the thigh, except where the patient is remarkably weak, so that he cannot bear the smallest loss of blood, and no steady intelligent assistant is at hand, to whom the compression of the artery in the groin can be prudently confided.

Whether the right or left thigh is to be removed, it is customary, in England, for the operator to stand on the patient's right side. In France, the surgeon places himself on the outer side for either limb, which plan, when the left limb is to be removed, leaves the duty of drawing up the skin and muscles entirely to the assistant. (*Velpeau, Nouv. Elém.* 8vo. t. i. p. 507.) The great advantage of the other method seems to be, that the surgeon's left hand can be thus more conveniently and quickly brought into use, than if he were always to stand on the same side as the limb he is about to amputate. This seems to be the only assignable reason for this habit; for, when the left thigh is to be amputated, it is certainly some inconvenience to have the right limb between the operator and the one that is to be removed. But this is found less disadvantageous than not having the left hand next the wound.

Mr. Guthrie, in speaking of amputations on the two lower thirds of the thigh, observes, that "in these cases the tourniquet should be used;" but in operations high up the thigh, he joins all other surgeons in recommending the inguinal artery to be compressed against the os pubis. (*On Gunshot Wounds*, p. 202.) The utility of slackening the tourniquet completely, however, as soon as the principal vessels are secured,—a piece of advice delivered by this excellent surgeon,—I presume, cannot be right on the ground which he specifies, viz. the impediment made by the strap of the instrument to the retraction of the muscles, and the consequent difficulty, in high operations, of sawing the bone, *because in common practice the bone is always sawn before any of the vessels are secured;* and loosening the tourniquet entirely, while any arterial branches still require the ligature, must generally be objectionable, if loss of blood be a disadvantage. In flap-amputations, high up the limb, indeed, where the arteries are sometimes tied, before the division of the bone, the employment of a tourniquet at all is quite out of the question.

We know that it was an opinion of the late Mr. J. Bell, that the flow of blood through a large artery could not be completely stopped by pressure; and the late Mr. Hey adopted a similar notion, in consequence of seeing a case in which the application of two tourniquets to the thigh did not restrain the hemorrhage from a fungus hæmatodes of the limb. He says, the pressure of the tourniquet does not completely obstruct the passage of blood in the arteries; it only diminishes so much of the force of the current as to enable the vessels, *in a sound state*, to exert their natural contractile power so effectually as to prevent hemorrhage. (See *Hey's Pract. Ob.* p. 257, 258. ed. 2.) Of the inaccuracy of this doctrine, no man can doubt who sees the femoral artery with its open mouth on the face of a stump not bleeding, while the tourniquet is tight, or skilful pressure is kept up, but throwing out its blood to a great distance the instant the pressure is discontinued. Nor, I apprehend, can any surgeon, who has amputated at the shoulder, and seen how completely pressure commands the flow of blood through the open-mouthed axillary artery, join in the sentiment of John Bell and Hey upon this particular point. Here I can speak with confidence, because I have myself amputated at the shoulder, and assisted at this operation several times, and found the statements of the preceding writers perfectly and clearly contradicted. Were any further testimony required, I might cite that of Dr. Hennen, who mentions, amongst other facts, that in a shoulder-joint case, operated upon by Mr. Dease, the amount of blood, lost from the principal artery, was no more than the quantity contained between the point of pressure and the point of incision through the vessels. (*Principles of Military Surgery*, p. 257. ed. 2.) The same fact presented itself in the example, where I assisted Dr. Blicke in private practice.

Mr. Liston confirms the preceding statement, observing that pressure complete enough not only to stop the pulsation of an artery in a limb, but also to arrest completely the flow of blood, can be easily applied by means of the fingers only: and, in order to prove the correctness of this remark, he has repeatedly, when no proper assistant was at hand, compressed both the femoral and humeral arteries with the fingers of one hand, whilst, with the other hand, he removed the limb; and this, as he affirms, with the loss of much less blood than if he had followed the ordinary mode. His common practice is to let the pressure be made by an assistant; and, in one place, he declares, that he would rather trust to no very efficient assistant than put on a tourniquet. The ease with which the flow of blood through the largest arteries is commanded by manual pressure, is a fact likewise attested by Dupuytren, who only employed the instrument, which he terms the compressor, in a few special cases. (See *Leçons Orales, &c.* t. iv. p. 377.; *Elements*, part iii. p. 361.; and *Ed. Med. and Surg. Jour.* vol. xx. p. 44.) The following passage explains Mr. Liston's views of this subject: "In all cases, and in all situations and circumstances, hemorrhage can be restrained during the completion of the incisions, and during the employment of means to close the cut ends of the vessels, by means of very slight, but exact pressure on the trunk of the principal vessel. (See also *Dupuytren, Leçons Orales de Clinique Chir.* t. iv. p. 382.) *The point at which this should be applied should be at as short a distance as possible above the place of the incision, and at the same time above the origin of any branches which must be cut.* Not the slightest pressure should be made until the instant when the incisions are about to be commenced, so that no venous congestion may take place in the limb. All the blood in the limb below the incisions must necessarily be lost. The veins are more easily compressed than the arteries; and pressure made a short time before the operation may arrest the return of blood, whilst it may not stop its influx. Thus engorgement of the lower part of the limb is produced, and the quantity of blood that must be lost is increased. For a similar reason, pressure sufficiently firm to stop arterial hemorrhage, is to be continued till the principal branches are tied, and then entirely removed; for the continuance of even slight pressure will increase the flow of blood from the surface of the stump — blood flowing in, and being arrested in its venous return, trickles out through the open ends of the veins. If a circular band be used for the compression, such as the screw-tourniquet, it should be put on quickly, screwed up at once, and then the incisions should not be delayed one instant." The doctrines and practice of Baron Dupuytren, I will notice in the article HEMORRHAGE. Baron Dupuytren did not employ the common tourniquet, nor any kind of compress furnished with a handle (see *Leçons Orales de Clinique Chir.* t. iv. p. 298.); he sometimes availed himself of an instrument which he termed a compressor, and which makes pressure only on two opposite points of the limb. (See *Leçons Orales, &c.* t. iv. p. 386.)

If, then, the flow of blood through an artery can easily be commanded by pressure, how are we to explain the occasional continuance of bleeding, notwithstanding the pressure of one, or even two, tourniquets? Without doubt, by the fact that the pads of these instruments, when not duly arranged, do more harm than good, by raising the band off the vessel; and perhaps, also, in Mr. Hey's example, by the additional consideration, that tumours of the fungus hæmatodes kind include a large quantity of blood, and will bleed profusely, and for a considerable time after the main supply of blood to them is cut off. The same thing happens in the disease called aneurism by anastomosis, as I have had several opportunities of witnessing, but in no instance more strikingly than in one, where, some time after Mr. Hodgson had tied the radial and ulnar arteries, Mr. Lawrence divided every part of the finger, excepting the tendons and bone, and yet a considerable bleeding went on from the further side of the wound. (See *Méd. Chir. Trans.* vol. ix. p. 216.)

The application of the tourniquet is generally left too much to assistants; but, so far as my judgment extends, no operator is justified in commencing his incisions before he has examined, and fully satisfied himself that the instrument is correctly applied. Mr. Guthrie candidly tells us, that he once lost an officer, in consequence of hemorrhage during the operation, although the tourniquet was in the charge of a surgeon of ability; and the advice with which he follows this statement is worth recollecting: "In a case of this kind, where it (the tourniquet) is found of little benefit, the surgeon should not continue twisting and turning it, whilst his patient is bleeding, but quit it altogether, and compress the artery against the pubes." This maxim cannot be too highly commended.

The shape and size of the pad of the tourniquet are matters of importance. At St. Bartholomew's, the pads employed in my time were very firm, being composed of wood, or cork covered with leather, and rather thicker than the thumb, the upper surface being flat, and the lower, which was put against the thigh, being convex. They were about an inch and a half in length. Such pads answered extremely well, as I can affirm from the observation of some hundreds of amputations in that hospital. A common fault formerly was the employment of pads which were too large, and soft, and not judiciously shaped. As Mr. A. C. Hutchison remarks, the principal objection to a large pad is, that the band of the tourniquet is so much raised by it, that a considerable space is left on each side of it, where no compression is made on the limb, however closely the instrument may be screwed, and thus there will be a risk of hemorrhage from such vessels as happen to be in these situations. The same gentleman uses a pad, which is not thicker than a finger, and places it obliquely over the artery, so as to preclude the possibility of displacement. (*Pract. Obs. in Surgery*, p. 21—23.) Mr. Guthrie says, "the pad should be firm and rather narrow, and carefully held directly over the artery, whilst the ends of the bandage, in which it is contained, are pinned on the thigh. The strap of the tourniquet is then to be put round the limb, the instrument itself being directly over the pad, with the screw entirely free. The strap is then to be drawn tight, and buckled on the outside so as to prevent its slipping, and not interfere with the screw, which is to be turned until the pressure is sufficiently forcible to stop the circulation. If the screw require to be turned for more than half its number of turns to effect this, the strap is not sufficiently tight, or the pad has not been well applied, and they must be replaced." (*On Gunshot Wounds*, p. 204.)

In two amputations at St. Bartholomew's Hospital, I saw the tourniquet break after the soft parts had been divided; and as in one of these cases a good deal of blood was lost, because another tourniquet happened not to be in the room, and pressure on the artery in the groin was not immediately adopted, I coincide with such writers as recommend the rule of always having two tourniquets ready. Graefe even goes so far as to advise putting both of them round the limb before the operation commences (*Normen für die Ablösung grösserer Gliedmassen*, p. 48.); but, the frequency of a tourniquet breaking is not so great, as to demand such precaution; and the plan would be objectionable in thigh amputations, where it is a material advantage to have plenty of room between the place of the incision and the band which goes round the limb.

An assistant, firmly grasping the thigh with both hands, is to draw up the skin and muscles, while the surgeon, beginning with that part of the edge of the knife which is towards the handle, makes a circular incision, as quickly as possible, through the integuments down to the fascia, or, as Mr. Guthrie and Dr. Hennen recommend, even completely through it. According to Mr. Guthrie, the skin cannot be sufficiently retracted, unless the fascia be divided, which he appears to think ought rather to be drawn up with the integuments than dissected from them. (*On Gunshot Wounds*, p. 204—208.; also *Hennen's Military Surgery*, p. 263.) In this way, the necessity for all painful detachment of the skin from the fascia is superseded. However, in secondary amputations of the thigh, if the integuments are unsound, and cannot be retracted, Mr. Guthrie approves of their being dissected back. On the contrary, Langenbeck is very particular in enjoining surgeons to avoid cutting through the fascia by the first sweep of the knife, because he finds that the muscles are better held together, and can be more regularly divided, by cutting them and the fascia at the same time. (*Bibl. für die Chir.* b. i. p. 564.) Nor does M. Roux divide the fascia by the first incision. (*Mém. sur la Réunion immédiate de la Plaie après l'Amputation circulaire*, p. 9. 8vo. Paris, 1814.) While I was a student at St. Bartholomew's, the surgeons rarely or never cut through the fascia with the integuments, but aimed at carrying the knife perfectly down to it all round the limb. This at least ought to be done without fear of doing rather more; for, as Graefe observes, if the outer layers of the muscles be here and there a little touched, this occasions less pain, than the additional strokes of the knife for dividing any portion of the skin and cellular substance not completely cut through in the first instance. Graefe also dissents from Mynors and others, who are advocates for cutting the skin obliquely instead of perpendicularly, because he finds the thin edge of the integuments, thus separated from the subjacent cellular membrane, disposed to slough. (*Normen für die Abl. grösserer Gliedmassen*, p. 102.) Whether the fascia and subjacent muscular fibres be reached or not, is also deemed by Velpeau a matter of no consequence; the only essential thing being the perfect division of the skin. (See *Nouv. Elém. de Méd. Opér.* t. i. p. 508.) In a thigh of ordinary dimensions, the first incision should be made four inches below where it is intended to saw the bone. When the thigh is bulky, the large amputation knife will be found the best. Before beginning this first cut, the arm is to be carried under the limb, till the knife reaches almost round to the side on which the operator stands. With one sweep, penetrating at least to the fascia, the knife is then to be brought round to the point where it first touched the skin. Thus, the wound is more likely to be regularly made than by cutting first on one side, and then on the other, while the patient is saved some degree of pain, in consequence of the uninterrupted quickness with which the incision is made. At the same time, I ought to confess, that the late Sir C. Blicke, and some other surgeons, whom I have seen operate, completed the circle by two strokes of the knife, so well and expeditiously, that their capricious attachment to this plan could hardly be found fault with.

The next object is the preservation of as much skin as will afterwards, conjointly with the muscles, cut in an oblique direction, cover the end of the stump with the utmost facility. It is rather difficult to lay down any other general principles for the guidance of the surgeon in saving integuments. I am disposed to agree with several moderate writers, that the painful dissection of the skin from the muscles has been recommended and practised to a very unnecessary extent,—that is to say, unnecessary, if the division of the muscles be performed in the most advantageous manner. Graefe, one of the best surgeons at Berlin, does not dissect the skin from the muscles at all in amputating the thigh, but takes care, after making the cutaneous incision, to have the integuments and subjacent flesh very firmly drawn up before commencing the oblique division of the muscles. This retraction he also strongly advises to be done uniformly and smoothly all around the member, lest, in dividing the muscles, any irregular projection of the skin interfere with the requisite movements of the knife. (*Normen für die Abl. grösserer Gliedmassen*, p. 103.) Instead of dissecting back the skin, Dupuytren used to cut all the soft parts at once to the bone, which he next divided, after retracting the muscles. (*Dupuytren, Leçons Orales, &c.* t. iv. p. 297.) However, Langenbeck, another of the most skilful operators on the Continent, prefers detaching the integuments from the fascia for about two fingerbreadths (*Bibl. für die Chir.* b. i. p. 567.), as is the common practice in the London hospitals.

Some late writers, particularly Mr. Syme, in expressing their preference to muscle as a covering for the end of the bone, seem to forget one fact which I have often noticed, viz. that the muscular cushion, though at first thick and good, soon shrinks to a comparatively small mass. This is consonant to a general law in the animal economy, prevailing whenever the natural action of a muscle is lost or prevented. Sir Astley Cooper states, that the covering for the end of the bone must be integuments, and not muscles; for, if muscular fibres are preserved with the integuments, they will contract, and retraction of the skin covering the stump will be the result. (*Lancet*, vol. i. p. 148.) Brünninghausen also thinks skin a better and more durable covering for the end of the bone than muscular fibres, which after a time dwindle away; and thence he computes the quantity of integuments which ought to be saved, by the measure of the circumference and diameter of the member. Thus, when the limb is nine inches in its circumference, the diameter is about three; therefore, one inch and a half of skin on each side is to be saved. (*Erfahr. &c. über die Amp.* p. 75.) But this author cuts the muscles perpendicularly, so that he is obliged to separate much more skin from the flesh than is necessary, when the incision through the muscles is carried obliquely upward. Mr. Hey's method of calculation, which I shall presently notice, appears more adapted to ordinary practice; and he says, "the division of the posterior muscles may be begun at half an inch, and that of the anterior at three quarters, above the place where the integuments were divided." (*Pract. Obs. in Surgery*, p. 528. ed. 2.)

Dr. Hennen, by giving an oblique direction to all the incisions through the muscles, obviates the necessity for much dissection of the integuments; and he says that, in a small limb, he has repeatedly performed the operation with one sweep of the knife, cutting obliquely inwards and upwards at once to the bone. (*Principles of Military Surgery*, p. 265. ed. 2.) This author, like Mr. Guthrie, also recommends carrying the knife through the fascia in the first circular incision; and so does Mr. C. Hutchison, who makes no mention of dissecting back the skin, but simply states, that the "integuments and fascia being divided by a circular incision, and retracted upwards, as high as is judged necessary, the superficial muscles should next be divided," &c. (*Pract. Obs. in Surgery*, p. 23. 8vo. Lond. 1816.) We are, therefore, to conclude that he joins Graefe and others in thinking the separation of the skin from the fascia unnecessary. My own observations in practice lead me to believe, that the dissection of the integuments from the subjacent parts used formerly to be carried to an extent beyond all moderation and necessity; and that, as it is a most painful proceeding, and hurtful, by forming a large loose pouch for the lodgment of matter, it ought to be abandoned by every surgeon who follows the method of sawing the bone considerably higher than the first cut through the superficial muscles. Mr. Hey, like Desault (*Œuvres Chir.* t. 21. p. 545.), is an advocate for amputating with a triple incision, and for preserving such a quantity of muscular flesh and integuments as are proportionate to the diameter of the limb. By a *triple* incision, he means first an incision through the integuments alone; secondly, an incision through all the muscles, made somewhat higher than that through the integuments; and thirdly, another incision through that part of the muscular flesh which adheres to the bone, made round that point of the bone where the saw is to be applied. The proper distance of these incisions from each other, he says, must be determined by the thickness of the limb upon which the operation is to be performed, making allowance for the retraction of the integuments, and of those muscles which are not adherent to the bone. Supposing the circumference of the limb to be twelve inches where the bone is to be divided, the diameter is about four inches; and, if no retraction of the integuments were to take place, a sufficient covering of the stump would be afforded by making the first incision at the distance of two inches from the place where the bone is to be sawn, that is, at the distance of the semi-diameter of the limb on each side. But, as the integuments, when in a sound state, always recede after they are divided, it is useful to make some allowance for this recession; and to make the first incision, in this case, at least two inches and a half, or three inches, below the place where the bone is to be sawn. As the posterior muscles of the thigh retract a great deal in the process of healing, Mr. Hey advises their division to be begun half an inch above the place where the integuments were cut, and the anterior muscles three quarters of an inch. The integuments, says he, will retract a little both above and below the place where they were divided; but the distance from that place must be computed from the mark left upon the surface of the muscles in dividing the integuments. Thus, in fact, in a common thigh amputation, Mr. Hey deemed it necessary to detach the skin from the muscles merely to the extent of half an inch at the back part of the limb, and of three quarters in front: a very different practice from the old custom of making quite a bag of integuments, and turning them back, as the upper piece of a glove is turned down, or rather as the sleeves of a coat are turned up.

In common amputations of the thigh, Roux strongly disapproves of separating the skin far from the muscles, as a circumstance highly unfavourable to the healing of the wound by adhesion. He divides only a few of the cellular bands between the integuments and fascia; and occasionally he has imitated M. Louis in cutting through the skin and superficial muscles together. (*Mém. sur la Réunion de la Plaie après l'Amputation, &c.* p. 9.)

I believe the generality of the best operators are now convinced of the impropriety of dividing the muscles exactly in the manner directed by Mr. Alanson, viz. by letting the knife revolve uninterruptedly all round the bone, with its edge turned obliquely upwards, towards the point where it is intended to apply the saw. It is a topic, indeed, to which I have already called the reader's attention in the foregoing columns. Langenbeck says, that he is perfectly convinced of the impossibility of forming a conical wound with one stroke of a large amputating knife, and joins Mr. Hey in approving of the triple incision. (*Bibl. für die Chir.* b. i. p. 564.) The objections, first urged by Wardenburgh against Alanson's method, are mathematically correct, inasmuch as the course of the edge of the knife, in this gentleman's method, must be spiral, and the end of the incision be considerably higher than the beginning of it. Such must be the result of performing the division of the muscles all round the limb by one continued stroke of the knife, with its edge directed obliquely upwards; for the idea of making the knife revolve in this manner, while its point is confined to an imaginary, regular, determinate circle on the bone, I believe, is now abandoned as not really practicable. Yet, with the exception of Desault, who confined himself to the triple incision, conducted on the principles of M. Louis (*Œuvres Chir.* t. ii. p. 547.), few experienced surgeons refuse to acknowledge that in this operation immense advantage does proceed from the oblique division of the muscles. The honour of bringing this method into practice, Mr. Alanson still unquestionably merits, however he may have erred in recommending the conical wound to be made with one sweep of the knife. In amputating the thigh at its upper part, Velpeau believes the oblique division of the muscles, with the edge of the knife turned upwards, to be advantageous, as, without this precaution, or the saving and turning back the skin to the extent of two inches, the sides of the wound will not admit of being brought together. (*Nouv. Elém. de Méd. Opér.* t. i. p. 508.) Nor are there many living surgeons who entertain a doubt of the excellence of the principle inculcated by M. Louis, respecting the utility of dividing the loose superficial muscles first, and then such as are deeper and adherent to the bone. In fact, a combination of this last method, with the oblique division of the muscles, not exactly by one, but several strokes of the knife, constitutes the mode of amputating at present most extensively adopted, and sometimes termed, as already mentioned, amputation by a triple incision. Thus, after the skin is cut, and as much of it retracted and saved as is deemed necessary, the operator cuts through the loose muscles of the thigh, at the edge of the retracted skin, first those on the fore part of the limb, and then such as are situated behind. For this purpose, he makes two or more sweeps of the knife, as may be found necessary, carefully directing them obliquely upwards towards the point, where he means to saw the bone. The oblique division of the muscles does not merely enable the operator to saw the bone higher up than he could otherwise do, and leaves, at the same time, more muscle for covering its extremity, but it is a preservation of sound, undetached integuments, which assuredly form the most efficient and durable covering for the stump. I say this, without precisely coinciding with Brünninghausen, who, trusting entirely to skin for covering his stumps, makes an extensive detachment of it from the muscles, and then cuts straight down to the bone. The loose muscles actually cut through now retract considerably, leaving those which are deeper and attached to the bone in a condition to be cut higher up than could have been previously done. Lastly, these are also to be divided with the edge of the knife directed obliquely upwards towards the place where the saw is to be applied. Some operators do more than this; for, after cutting down to the bone, they follow the plan of Celsus, and detach the flesh from its whole circumference upwards with a scalpel, to the extent of about another inch, in order to be enabled to saw the bone still higher up. "*Inter sanam vitiatamque partem incidenda scalpello, caro usque ad os, reducenda ab eo sana caro, et circa os subsecanda est, ut eâ quoque parte aliquid ossis nudetur.*" This method, I think, deserves commendation, because it may have considerable effect in hindering a protrusion of the bone, if it does not, in conjunction with the foregoing method of operating, and judicious dressings, render this disagreeable event quite impossible. However, I shall never forget a poor soldier, whose thigh had been amputated in Bergen-op-Zoom, and who was brought about ten days after the operation into the military hospital at Oudenbosch under my care. Not the slightest union of any part of the wound had taken place; abscesses had formed under the fascia on every side of the stump; the loose skin was literally a large bag of purulent matter; the muscles were wasted to almost nothing, and their remains retracted, and shrinking still further away from the extremity of the bone, which protruded at least three inches beyond the soft parts. This unfortunate man had been attacked with chronic tetanus soon after the operation, and, probably, it was to the disturbance of the stump by the effects of that disease, and to the strong and continual tendency of the muscles to retract themselves, induced by this state of the system, that the deplorable state of the stump was to be attributed. He lingered nearly a fortnight in the hospital before he died; previously to which event, large abscesses, communicating with the hollow of the stump, surrounded the greater part of the pelvis. As I had every reason to believe that the operation had been skilfully done, perhaps when I say that the above mode of amputating will make a protrusion of the bone impossible, it is not exactly correct, as the occurrence may sometimes originate from causes which are quite independent of the particular way in which the operation has been executed.

The practice of detaching the bone from the circumjacent flesh to the extent of about an inch, after the other principal incisions are completed, as advised by Celsus and Louis, I have sometimes seen followed at St. Bartholomew's Hospital, and have adopted it myself on other occasions, with the decided advantage of letting the bone be sawn higher up than could otherwise have been effected. Mr. Guthrie, after the incisions down to the bone, even recommends dissecting back the muscles from it "*for the space of two or three inches*, as the size of the limb, or other circumstances, may require;" but I should be reluctant to imitate the practice to this extent, though inclined to think most favourably of it within more moderate limits. If we reckon that three inches of the member lie between the first circular cut in the skin, and the place where the knife arrives at the bone, and then take away two or three inches more of the femur, it is clear that, in many examples, we should be getting very high up the limb; and if a detachment of the muscles from the bone, to the extent of two or three inches, were thus made, it would at all events be of no service, unless the bone would admit of being sawn at this great distance from the termination of the oblique division of the muscles. However, if this were truly practicable (a point which I leave for others to discuss), it would certainly be consonant to the excellent general maxim laid down by J. L. Petit, that in amputation, as much of the bone, and as little of the flesh, should be taken away as possible. (See *Traité des Mal. Chir.* t. iii. p. 150.) When this final detachment of the deep muscles from the bone is adopted, particular care, as Roux observes, should be taken always to divide the thick aponeurosis connecting the triceps to the linea aspera. (*Mém. sur la Réunion de la Plaie après l'Amputation*, p. 10.)

With respect to Desault's method of amputating the thigh by a circular incision, already mentioned, he considered turning the knife obliquely upwards quite unnecessary. His plan was to cut through the muscles, layer after layer, with the precaution of retracting the first stratum before he divided the second; the latter was then cut through on a level with the flesh that had been previously divided and retracted, and so on down to the bone. This, says he, is the right way of forming a true hollow cone, of which the integuments, which were drawn up before the muscles were cut, form the base, from which are gradually continued the various layers of muscles, and the highest point of which is the bone itself. (*Œuvres Chir. de Desault, par Bichat*, t. ii. p. 547.)

Dupuytren objected to this last method as tedious and painful, on account of the repeated division of the same textures by it. Hence, he preferred cutting through the integuments and muscles down to the bone with a single stroke of the knife, sometimes perpendicularly, sometimes obliquely. The contraction of the muscles, and the retraction produced by the assistant, who grasped the limb above the incision, instantly caused the wound to assume a conical projecting form. At the base of this cone, close to the edge of the retracted skin and muscles, the knife was applied again, and the flesh here drawn up as soon as divided. By cutting the muscular strata in succession, as they presented themselves under those already divided, and retracted, Dupuytren was able to lay bare the bone six inches above the line of the first incision. The operation was rapidly completed, and the patient saved from all the agony resulting from the dissection of the skin from the muscles. (See *Leçons Orales de Clinique Chir. de M. Le Baron Dupuytren*, t. iv. p. 297.) In this plan, however, the deep muscles attached to the bone must have been cut through more than once, if the operator really made his knife penetrate to the bone at the first stroke, as is represented. The avoidance of the tedious dissection of the skin, the saving of pain, and the abridgment of the operation, were not the only considerations in favour of this method, for one still greater influenced Dupuytren, namely, that of not destroying the natural connections of the skin to the subjacent parts, and preserving the sources of its nutrition. Hence, he followed this plan in all circular amputations of parts of limbs, where there was only one bone. (*Op.* cit. t. iv. p. 351.)

All the muscular fibres, on every side, having been cut down to the bone, a piece of linen, somewhat broader than the diameter of the wound, should be torn at one end, along its middle part, to the extent of about eight or ten inches. This is called a retractor, and is applied by placing the exposed part of the bone in the slit, and drawing the ends of the linen upward on each side of the stump. In this manner, the retractor will obviously keep every part of the surface of the wound out of the way of the saw. Graefe thinks, that, in amputations of parts where there is only one bone, the unslit portion of the linen should always be applied over the anterior muscles, as these ought constantly to be most evenly kept back, so that no projection of them may interfere with the action of the saw. (*Normen für die Ablösung grösserer Gliedm.* p. 105.) That meritorious surgeon, J. L. Petit, whose name I always mention with pleasure, strongly commends the use of the retractor, the ends of which he drew over the anterior muscles: he says, that he has employed this simple and natural means, but that it did not suit the taste of every body, especially of those who consider all the merit of an operation to consist in the quickness of its performance, or who think it satisfactory reasoning to say, this is not their method. (*Traité des Mal. Chir.* t. iii. p. 152.) I have seen the saw do so much mischief, in consequence of the operator neglecting to use the retractor, that my conscience obliges me to censure such surgeons as neglect to defend the soft parts by this simple contrivance. There are some who have rejected the use of the retractor, because they have seen it get under the teeth of the saw, and obstruct the action of the instrument; but this very circumstance adduced against the retractor is, when considered, the strongest one that could possibly be brought forward in its favour, as the surface of the wound itself, and particularly the edges of the skin, would, in all probability, suffer the same fate as the linen, by getting under the teeth of the saw, if no retractor were employed, in attempting to saw the bone high up, as closely as possible to the soft parts. I think no one can urge any but the most frivolous objections to the use of the retractor, and I know that many who have been with myself eye-witnesses of the mischief frequently done by the saw in amputations, are deeply impressed with an aversion to the neglect of this bandage. I have often seen the soft parts skilfully divided; and I have, in these same instances, seen the operators, directly afterwards, lose all the praise which every one was ready to bestow, by their actually sawing through one half of the ends of the muscles together with the bone. Men who have had fortitude not to utter a sigh, nor to let a groan be heard, in their previous sufferings, have now had their involuntary cries extorted from them by unnecessary, unjustifiable torture. But, besides defending the surface of the stump from the teeth of the saw, the retractor will undoubtedly enable the operator to saw the bone higher up than he could otherwise do.

Mr. Liston pronounces all kinds of retractors superfluous. Here it should be remembered, that this gentleman's practice is that of flap-amputation, to which he gives the universal preference; a method in which unquestionably the retractor may be dispensed with, as, while the saw is acting, one, or both, of the flaps can be effectually held out of the way by an assistant. (See *Edinb. Med. and Surg. Journ.* vol. xx. p. 43–45.) Here, however, I am treating of amputation by the circular incision, in which the retractor is too useful to be relinquished. Were any further authority necessary in support of the practice of employing the retractor, I might refer to that of Dupuytren (see *Leçons Orales de Clinique Chir.* t. iv. p. 298.), whose directions for its application are the following:—If there is only one bone, it is to be placed in the angle of union of the two tails of the retractor, which are to be brought over the anterior surface of the limb, and made rather to cross one another. Thus, the retractor forms a sort of bag covering the wound, and out of the centre of which the bone passes, and becomes the more denuded in proportion as the assistant draws the retractor towards the trunk.

One proceeding, which seems fit for reprobation, and which, indeed, Mr. Alanson very properly condemned, is the practice of scraping up the periosteum with the knife, as far as the muscles will allow. Nothing seems more probable, than that this may be the cause of the exfoliations which occasionally happen after amputations. At all events, it is a superfluous, useless measure, as a sharp saw, such as ought to be employed, will never be impeded by so slender a membrane as the periosteum. All that the operator ought to do is, to take care to cut completely down to the bone all round its circumference. Thus a circular division of the periosteum will be made, and upon this precise situation the saw should be placed. This is the method which was approved of by J. L. Petit. (*Traité des Mal. Chir.* t. iii. p. 159.) It is what I have always done and recommended; yet it must be confessed, that differences of opinion prevail about the necessity, and modes, of dividing the periosteum. Graefe, in common with several others, entertains considerable apprehension of the effects of the periosteum being torn and lacerated by the saw, exfoliations of the bone and abscesses up to the joint being possible consequences of the rude separation and inflammation of this membrane. Hence he is an advocate for making a circular cut through it at the place where the saw is to be applied, and then scraping away all below this point in the direction downwards. (*Normen für die Abl. grösserer Gliedm.* p. 165. and 105.) Perhaps no very great objection may lie against this mode, which is not uncommonly followed, though I have some doubts of its real utility, as it scarcely seems practicable in the midst of the oozing of blood to hit with the saw the precise line at which the remains of the periosteum terminate; and, in confirmation of the safety of Petit's practice, Mr. Guthrie's experience may be adduced, who says, "I have often sawn through the bone, without previously touching the periosteum, and the stumps have been as soon healed, and with as little inconvenience as any others. (*On Gunshot Wounds*, p. 88.) A modern author, impressed, like many others, with the fear of tearing the periosteum with the saw, differs from them in thinking it best to scrape the periosteum upwards, by which means, he says, that at least half an inch of this membrane, and a proportionate quantity of muscular fibres, may be preserved for covering the end of the bone, inasmuch as the muscular fibres, adherent to the periosteum, will remain connected with it; an advantage which this author deems very important while the edges of the bone are sharp. In amputation below the knee, he considers the method highly useful, as the sharp edge of the tibia may be not merely covered with skin, but with periosteum and the cellular membrane connected with it. Since his adoption of this practice, he assures us that he has not for a long time seen any exfoliation of the tibia, and never any protrusion of the bone of a stump. (*Brünninghausen, Erfahr. &c. über die Amp.* p. 65, 66. 8vo. Bamb. 1818.) Baron Dupuytren passes the knife circularly through the periosteum close to the retracted soft parts, and then detaches it upwards and downwards with the heel of the knife. (*Leçons Orales de Clinique Chir.* t. iv. p. 299.)

But, in no part of amputation, do operators in general display more awkwardness than in sawing the bone, though, if we except directing the saw against the flesh, the faults are here less pernicious in their consequences than the errors already noticed. At the time of sawing the bone, much depends upon the assistant who holds the limb. If he elevate the lower portion of the thigh bone too much, the saw becomes so pinched that it cannot work. On the other hand, if he allow the weight of the leg to operate too much, the thigh bone breaks before it is nearly sawn through, and its extremity is splintered. It is one of the most common remarks of such persons as are in the habit of frequently seeing amputations, that the part of these operations, which a plain carpenter would do well, foils the skill of a consummate surgeon, and few operators acquit themselves well in the management of the saw. Many of them begin the action of this instrument by moving it in a direction contrary to the inclination of its teeth. Many, seemingly through confusion, endeavour to shorten this part of the operation, by making short, very rapid, and almost convulsive strokes, with the saw. Almost all operators fall into the error of bearing too heavily on the instrument. That operator will saw best, who makes the first stroke of the saw by applying its heel to the bone, and drawing the instrument across the part, towards himself, so as to make a slight groove in the bone, which serves very materially to steady the future movements of the instrument; and who makes long regular sweeps with the saw, at first rather slowly than quickly, rather lightly than heavily. The saw is directed by Dupuytren to be applied perpendicularly, and worked in the beginning slowly, but afterwards more quickly, in proportion as the groove becomes deeper, and the risk of the instrument getting out of it is lessened. When the bone is nearly divided, the sawing should proceed with the greatest gentleness. Then the assistants who hold the opposite parts of the limb, should redouble their care to maintain them in their natural directions. (See *Leçons Orales de Clinique Chir.* t. iv. p. 300.) Mr. Liston places himself so that he may grasp the part to be removed during the sawing of the bone, without change of position. He makes the incisions with the left hand free; but, as soon as the saw is in the right, he takes firm hold of the limb below the wound. He disapproves of entrusting the limb to an assistant during the sawing, and lays it down as a rule, that the management of the lower part of the limb should always be left to the person using the saw. The saw, he says, may be worked either horizontally or vertically, but the latter direction seems to him best, because, when the section is nearly completed, the uncut part of the bone is deep, and less likely to snap on the weight of the limb, or undue pressure, operating downwards. (See *Liston's Elem.* part iii. p. 364.) But, there is often a fault in the construction of the saw itself, which impedes its action, quite independently of any fault on the part of the surgeon. I allude to the edge of the instrument not being a little broader than its blade. When the saw is well made, the teeth always make plenty of space for the movement of the rest of the instrument. The saw, recommended by Mr. Guthrie, cuts with both edges, backwards and forwards, which expedites the operation, and (what is of more consequence) helps to prevent splintering when the bone is nearly divided, because the division can be finished by the backward motions; which are the most gentle. (*On Gunshot Wounds*, p. 89.) This innovation, Velpeau informs us, is not adopted in France. (*Nouveaux Elém. de Méd. Opér.* t. i. p. 299.)

If the bone happen to break before the sawing has been finished, the sharp-pointed, projecting spiculæ, thus occasioned, must be removed by means of a strong, cutting sort of forceps, termed *bone-nippers.* The perpendicular division of the bone leaves a sharp edge at the extremity of its circumference: it is not the common practice to take any measures for the removal of such sharpness; yet Graefe recommends filing it away (*Op.* cit. p. 66.), and Mr. A. C. Hutchison makes it an invariable rule, whether there be any occasion to use the bone-nippers or not, "to take off the asperities, and scrape, or endeavour somewhat to round, the sharp cut edge of the bone with a strong blunt scalpel, in order to prevent the soft parts from being injured, when brought over the end of the bone in forming the stump." (*Pract. Obs. in Surgery,* p. 24.) Though I have not followed this practice, or rather the part of it which relates to cutting off the edge of the bone, nor seen it adopted in London in amputation of the thigh, I know of no objection to it, unless it be on the score of its inutility, and the delay which it occasions. All projecting points of bone, it is the ordinary custom to remove.

After the removal of the limb, the femoral artery is to be immediately taken hold of with a pair of forceps, or with Assalini's double tenaculum, and tied with a firm, round, smallish ligature. (See Ligature.) Care is to be taken to leave the nervus saphænus major out of the noose. Its diminutive size prevents it from being readily seen; but as it is always situated within the sheath, and on the outer and front part of the artery, in the middle third of the thigh, there ought to be no great difficulty in finding it. (*Velpeau, Op.* cit. t. i. p. 506.) None of the surrounding flesh ought to be tied, though the ligature should undoubtedly be placed round the artery, just where it emerges from its lateral connections. The late Mr. Hey was accustomed to tie the femoral artery twice, leaving a small space between the ligatures. Strong reasons against this plan will be found in the article Hemorrhage. The smaller arteries are usually taken up with a tenaculum. The tenaculum is not well suited for the larger arteries, because it readily tears their coats; but it answers excellently for the smaller ones, which it draws out with great promptitude. It has also the advantages of not letting the vessel slip away, as the common forceps does; and of admitting of being held by anybody, even a child, while the surgeon applies the ligature; a consideration of importance in places where no professional assistant is at hand. (*Dupuytren, Leçons Orales de Clinique Chir.* t. iv. p. 396.) After tying as many vessels as require it, the best practice is to cut off one half of each ligature, near the knot on the surface of the stump. One portion is quite sufficient for withdrawing the ligature, when this becomes loose; and the other, being only an extraneous body, and productive of irritation and suppuration, should never be allowed to remain.

The plan, here recommended, is founded upon hat valuable principle, which teaches us to lessen, as much as possible, the quantity of extraneous matter in a wound; and as one half of the ligature answers for withdrawing the noose, as soon as loosened, I never follow a method occasionally advised, viz. that of leaving both ends, and twisting them together into one cord, by means of which, when further twisted at the proper period, it is alleged, that the detachment may be more quickly brought about.

My friend, the late Dr. Hennen, in his excellent publication, ascribes the improvement of removing one half of the ligature to Dr. James Veitch, who, in April, 1806, published some valuable precepts relative to the mode of tying the arteries in amputation. (See *Edinb. Med. and Surg. Journal,* vol. ii. p. 176.) But, highly as I approve of the tenor of the anonymous paper here referred to, it is impossible for me to suppose that Dr. Veitch could be the first who suggested such improvement. When I went to St. Bartholomew's Hospital, in 1797, no surgeon of that hospital ever followed any other mode; and the practice was then so far from being new there, that gentlemen who had been at the hospital seven years before that date, saw one half of each ligature regularly cut off, the very first time of their attending an operation there. The use of broad ligatures, and the inclusion of a considerable quantity of flesh in the noose together with the vessels, were also practices quite exploded at St. Bartholomew's at the very beginning of my apprenticeship. Dr. Veitch, however, seems to merit the honour of having been the first to set the example of *tying every vessel, the femoral, as well as the smaller arteries, with a single silk thread,* taking care to include, as far as was possible, nothing but the artery; and when this had been done, he took off one half of each ligature, as near as possible to the knot, "so that the foreign matter introduced was a mere trifle, compared with what I had been accustomed to see." (*Edinb. Med. and Surg. Journ.* vol. ii. p. 178.) The use of a *single silk thread,* therefore, was the part of these improvements originating with Dr. Veitch.

Mr. Alanson directs the ends of the ligatures to be left hanging out at the two extremities of the wound. But when a ligature is situated in the centre of the wound, it is best to bring it out between the strips of adhesive plaster, at the nearest part of the surface; otherwise its running across one half the wound to get at either angle would create a great deal of unnecessary irritation and suppuration. The advantages of this method of placing the ends of the ligatures were well explained by Dr. Veitch; but his practice, like the innovation of cutting off the half of each ligature, has been common in the London hospitals, and at Bartholomew's in particular, many years earlier, I presume, than the case referred to by this gentleman; since it has been familiarly adopted in those institutions ever since 1797, as I can testify from my own personal observation, and, indeed, at a much earlier period, according to the report of those gentlemen now living, who were my seniors. These remarks are offered, without the slightest intention of detracting from the merits of the above-mentioned paper, which is replete with valuable advice; nor am I influenced by any design of throwing honour on the memory or character of any other individual at the expense of Dr. Veitch, being at this time unacquainted with the exact periods when either this improvement, or that of removing the half of each ligature, commenced. Baron Dupuytren, and M. Roux declare their preference to the method of bringing out all the ligatures at the lower angle of the wound; the benefit of having them brought out thus low, so as to keep up a drain for any pus that may form, being in their opinion greater than that of arranging them at the points of the wound nearest to them. (*Mém. sur la Réunion de la Plaie après l'Amp.* p. 12.) Dupuytren, who only approved of endeavouring to procure union by the first intention at every point, when amputation had been performed without delay, for a gunshot wound, or other bad accident, on a person otherwise healthy, used in all cases to leave the lower part of the wound unclosed. Here he brought out the ends of the ligatures well twisted together into a single cord; and, for the purpose of still farther insuring an outlet for the pus, if the cord was small, he occasionally introduced a small cylinder of charpie into the posterior angle of the incision; for as it was his custom, after circular amputation of the thigh, to bring the sides of the wound partly together (see *Leçons Orales, &c.* p. 416.), so as to render the line of it transverse, I infer that he selected the inner angle of the incision as the outlet for the discharge and the place for the cord of ligatures.

As Dr. Hennen observes, the reducing the immoderate size of ligatures, the separating the threads of which they were composed, and placing them at convenient points along the face of the stump, or wound, and the actual removal of one half of each ligature, were amendments very slowly made; "but," says he, "an improvement which appears to me of great consequence, was the last of introduction, and is now the slowest of adoption, although, the artery once secured, and the value of adhesion duly acknowledged, it is the most obvious of all. I allude to the plan of removing the ends of the ligature altogether, and thus leaving to an extensive wound the greatest possible chance of immediate union." The first printed mention of this practice, as far as Dr. Hennen's investigations have discovered, was in a letter written by Mr. Haire, dated Southminster, Essex, Nov. 1786. "The ligatures," says this gentleman, "sometimes became troublesome, and retarded the cure. An intimate friend of mine, a surgeon of great abilities, proposed to cut the ends of them off close to the knot, and thus leave them to themselves. *By following this plan, we have seen stumps healed in the course of ten days. The short ligature, thus left in, commonly made its way out by a small opening in a short time, without any trouble, or the patient being sensible of pain.* (See *Lond. Med. Journ.* vol. vii.) Certainly, considering the thickness of the ligatures in use at the above period, this testimony of the success of the method, as Dr. Hennen remarks, is very satisfactory. (*Principles of Military Surgery*, p. 181, ed. 2.) In a letter received by me from Mr. Dunn, surgeon at Scarborough, and dated June 3. 1819, he tells me, "My predecessor, Mr. J. Wilson, the late partner of Mr. Travis, amputated a limb in 1792, or 1793, and cut off the ligatures close to the arteries, and no trouble ensued. He did this at the recommendation of Dr. Balcombe, of York, who had seen the method practised on the Continent." In September, 1813, Dr. Hennen, who was serving with the army in Spain, began the adoption of this plan, which, he expected, would not only prove useful in promoting immediate union, but in obviating any accidental violence to the ligatures, and the wrong interference of the younger dressers in trying to pull them away. Between September and January, thirty-four cases were treated in this way without any inconvenience following, or the small particles of silk left behind giving rise to any apparent irritation. Dr. Hennen also presented to Sir J. M'Grigor some of the small circles of silk, a part of which had come away with the dressings, while others had floated out on opening the little pustules, which formed over the face of the stump at the points where the arteries had been tied. Some few of the ligatures never made their appearance, and the patients complained of no uneasiness whatever. Convinced of the utility of the method, Dr. Hennen afterwards published an account of it. (See *Lond. Med. Repository*, vol. iii. p. 177. and vol. v. p. 221.) This gentleman subsequently found, that Dr. Maxwell of Dumfries had adopted the plan as far back as 1798; and Dr. Ferguson, who was at Stockholm during the peace of Amiens, saw it also then followed by some of the surgeons of that city, without any ill effects. (*Hennen's Military Surgery*, p. 175—178. ed. 2.) In July, 1814, Mr. Lawrence communicated to the Medical and Chirurgical Society of London, some cases and observations highly in favour of the practice; and the particularity, which he lays much stress upon, is using for the purpose minute firm ligatures, composed of what is called dentist's silk; a material which had been previously recommended by Dr. M'Sweeney in one of the volumes of the Edin. Med. and Surgical Journ. (See *Med. Chir. Trans.* vol. vi. p. 156.) In a paper of later date, he says, his further experience had confirmed the usefulness of the method; "that this plan, by diminishing irritation and inflammation, and simplifying the process of dressing, materially promotes the comfort of the patient, and the convenience of the surgeon, while it has not produced ill consequences, or any unpleasant effect, in the cases which have come under his own observation." According to Mr. Lawrence, the small knots of silk generally separate early, and come away with the discharge; that where the integuments have united by the first intention, the ligatures often come out rather later, with very trifling suppuration; and that, in some instances, they remain quietly in the part. (*Op.* cit. vol. viii. p. 490.)

When this plan is tried, single strong threads and silks, or rather the kind of ligature which will be described in another place (see LIGATURE), should be employed; for, otherwise, the knots would be large, and likely to create suppuration and future trouble. The practice was tried by Delpech at Montpellier; but it is not explained whether he used single threads, or silk, or whether any inconveniences resulted from the method. (See *Rélation d'un Voyage fait à Londres en* 1814, *ou Parallèle de la Chirurgie Anglaise avec la Chirurgie Française, par P. J. Roux*, 8vo. 1815.) Yet candour requires me to state that the method has gained but few advocates in this country. One well-informed writer (see HEMORRHAGE) has recited a case, and some experiments, which are unfavourable to the practice. (*Crosse*, in *Lond. Med. Repository*, vol. vii. p. 355.) By Sir Astley Cooper, the practice was found to occasion suppuration, and he has therefore given it up. (*Lancet*, vol. i. p. 149.) Mr. Guthrie, in two or three instances, has also seen some ill-looking abscesses arise from the presence of the bits of ligature, though he approves of the plan where the wound will not unite by the first intention, which, however, can rarely be known beforehand. (*On Gunshot Wounds*, p. 941.) When amputation is performed in crowded hospitals, where hospital gangrene is prevailing, Delpech was an advocate for the plan, because it enabled the surgeon to bring the lips of the wound more perfectly together. By this means, as his experience had taught him, the risk of the wound being infected was materially lessened. (*Chirurgie Clinique*, t. i. p. 83.) The small perticles of the ligatures, enclosed in the stump, he says, are discharged at a period when the patient has regained strength enough to be removed into a healthy atmosphere; little openings being produced for their escape, which heal up in twenty-four hours.

Sometimes, the sawn surface of the bone itself bleeds rather profusely. When this happens, it is an excellent plan to hold a compress of lint over the end of the bone, during the time requisite for securing the rest of the vessels. The bleeding from this source will then give no further trouble. At the end of this period, the compress may generally be taken away, the bleeding from the bone having entirely ceased. The surgeon ought not to be content with tying only such vessels as he observes throwing out blood, while the patient is faint with pain; he should endeavour to rouse him from that faintish state by a cordial, and then, wiping off the coagulated blood with a sponge wet in warm water, he should examine narrowly all the surface of the stump; for otherwise he may expect to be obliged by a fresh hemorrhage to undo all the dressings. (*On Amputation of the Larger Extremities*, p. 475. *Monro's Works.*)

When there is merely an oozing from small vessels, Bromfield's advice to loosen the tourniquet completely is highly proper, as this measure, and washing the stump with a little cold water, will put an entire stop to such bleeding, without any occasion for more ligatures. A good deal of blood is sometimes lost from the mouths of the larger veins; and where they bleed much in debilitated subjects, I think Dr. Hennen is right in recommending them to be tied. (*On Military Surgery*, p. 264.) There is no necessity for doing so, however, in ordinary cases; nor should I be disposed to imitate Mr. Hey, who, in consequence of having seen a few instances of bleeding from the femoral vein, generally enclosed that vessel in the ligature along with the artery. (*Practical Obs. in Surgery*, p. 530. ed. 2.) This method was sanctioned by the eminent Desault, who says, that if the vein be left open, and the bandage at the upper part of the limb be too tight, the blood regurgitates downwards, and hemorrhage takes place, as this surgeon assures us he has often seen. When the vein and artery lie close together, as often happens, one branch of the forceps is to be introduced into the artery, and the other into the vein; which being done, the two vessels are to be drawn out together, and included in one ligature; but if they are not so near together, they must be tied separately. (*Œuvres Chir. de Desault, par Bichat*, t. ii. p. 550. 8vo. Paris, 1801.) In the hospitals of London, it is not the usual practice to tie the femoral vein, and, except in particular cases, I consider the custom wrong, because a ligature on a large vein sometimes excites a dangerous and fatal inflammation within the vessel, while the intervention of the vein between the one side of the circle of the ligature and the artery, must rather tend to hinder the thread from operating in the most desirable manner upon the latter vessel. For some remarks on venous bleeding during operations, and an account of Dupuytren's views and practices under such circumstances, see Hemorrhage. If the end of the great sciatic nerve should project too much, the best plan is immediately to cut it off, as advised by M. Descot. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 506.)

Of Dressing the Stump.

The wound is now to be evenly closed with strips of sticking-plaster, so that the edges of the skin may form a straight line across the face of the stump. This was the mode commended by Alanson, and is what is preferred by the generality of surgeons in this country. It is also advised by Graefe, Delpech, and others. (*Normen für die Abl. grösserer Gliedm.* p. 106.; *Chirurgie Clinique de Montpellier*, t. ii. p. 395.; *Guthrie on Gunshot Wounds*, p. 208.) Over these plasters and the ends of the ligatures, it is best to place some pieces of lint, spread with the unguentum cetaceum, in order to keep such lint from sticking, which becomes an exceedingly troublesome circumstance, when the dressings are to be removed. I am decidedly averse to the plan of loading the stump with a large mass of plasters, pledgets, compresses, flannels, &c.; and I see no reason why the strips of adhesive plaster, and a pledget of simple ointment, should not suffice, when supported by two cross bandages, and a common linen roller, applied spirally round the limb, from above downward. The first turn of the roller, indeed, should be fixed round the pelvis, while the lower circles secure the cross bandages, often called the Malta cross, over the end of the stump. It is also an excellent method to leave some little interspaces between the plasters, and in summer to keep the linen bandages constantly wet with cold water. In this way, any discharge will readily escape, and the parts, being kept cool, will be less disposed to hemorrhage and inflammation.

Sir Astley Cooper states, that he has seldom succeeded with his stumps above the elbow or knee, when a roller was not employed, which, he says, prevents retraction of the muscles and extensive suppuration. After applying the roller, and bringing the integuments together, he merely puts three strips of adhesive plaster over the wound, and one round the stump, to keep the ends of the plaster in their place: in hot weather he applies a lotion of spirit of wine and water. (*Lancet*, vol. i. p. 150.)

I am completely of opinion with Mr. Alanson, that the elastic woollen cap, sometimes placed over all the bandages and dressings, if not put on with a great deal of care, has a tendency to push the skin backward from the extremity of the stump; and as it must also heat the part, its employment should be discontinued. In the North London Hospital, stumps are very lightly dressed, and for the first few hours, Mr. Liston, who always practises flap-amputation, merely keeps the flaps together with two or three sutures, and lays over the stump, linen or lint wet with cold water. The best position for the stump is that in which it is supported on a small pillow, with the thigh moderately bent.

If possible, the dressings should never be removed before the fourth day, not reckoning the one on which the amputation is performed; and Sir Astley Cooper even prefers the sixth or eighth day; merely removing on the fourth one strip of plaster, in order to let out any confined matter. (See *Lancet*, vol. i. p. 150.) Monro also set down the fifth, sixth, or seventh day, as generally soon enough for the change of the dressings. He allows, however, that, if the smell of the wound should become offensive, the outer dressings may be removed sooner. Even when the dressings are to be taken away, it will frequently be found useful not to remove one strip of plaster; but the stump must be made clean, and any discharge washed away. These, and other valuable precepts, derived from the eminent Dr. A. Monro senior, are worthy their great source, and the correctness of them promises to be acknowledged for ever.

The manner of renewing the dressings of stumps is, indeed, a very important business, which should never be intrusted to mere novices; for in removing off the straps of sticking plaster, if great care be not taken, the slight and newly formed adhesions may be torn asunder. Thus, as Mr. A. Hutchison has remarked, if the strap be pulled off by holding one end of it at nearly a right angle with the adhering part, the flap will be raised up with it, and thus a separation of the newly united parts will be produced. "My plan," says he, "is to reflect the raised end of the strap close down upon the adhering parts, and to bring it gently forward with one hand, while the removing part of the strap is followed by two fingers of the other placed upon the skin, &c.; and when one end is detached from its adhesion, as far as the line of incision on the face of the stump, in like manner the other end is brought down and wholly removed." (*Practical Obs.* p. 46.)

In order to facilitate the removal of the plasters, and save the patient a great deal of pain, I follow the plan of letting warm water drop over them from a sponge for a few minutes previously to the attempt to remove them. In the early part of the treatment, it is also a valuable rule never to let every strap of plaster be off at once, so as to leave the flesh quite unsupported. Some skill and care are also invariably necessary to avoid pulling away the ligatures with the dressings.

At the end of five or six days, the surgeon may begin to try, in a very gentle manner, whether any of the ligatures are loose; observing rather to twist, than suddenly pull them directly outward. However, he should not use the smallest force, nor persist if the trial create pain. One would hardly try whether the ligature on the main artery were loose, before the tenth or twelfth day, for it rarely comes away before the expiration of a fortnight. If minute ligatures made of dentist's silk be employed, and both their ends cut off close to the knot, of course, this delicate business of trying to get rid of the irritation of these foreign bodies is entirely superseded.

Though, in the above account, I have directed the edges of the wound, after the amputation of the thigh, to be brought together in such a way that the wound shall appear as a line across the face of the stump, yet there are instances in which the bone seems most easily and conveniently covered, by making the line of the wound in a perpendicular direction. Mr. B. Bell, indeed, generally approved of it, as affording a ready outlet for matter; it is likewise directed by Sir C. Bell (*Op. Surgery*, vol. i.), by Roux (*Mém. sur la Réunion immédiate de la Plaie après l'Amp.* p. 11.), and by Dr. Hennen (*On Military Surgery*, p. 265. ed. 2.).

On the other hand, Mr. C. Hutchison objects to it, because it seems to him, that when a stump, thus put up, is laid on a pillow, the pressure tends to separate and open the lower part of the wound. (*Pract. Obs. on Surgery*, p. 37.) Delpech was also led, by the view he took of the consequences of suppuration, and the contraction of cicatrices, to prefer bringing the sides of the wound together after the circular amputation of the thigh, so that the line of the cicatrix might be transverse, and not perpendicular. His reason was, that most of the ligatures, which unavoidably produce suppuration, are placed on branches of the profunda in the posterior part of the limb; consequently, here the greatest contraction follows cicatrization, and the anterior flap is thereby drawn over the extremity of the bone in the most advantageous manner (*Chirurgie Clinique de Montpellier*, t. ii. p. 395.); the muscles in front of the femur also contract to a less extent than those behind; another reason assigned by Velpeau, in explanation of the fact, that, after the circular amputation of the thigh, the cicatrix is drawn backwards or inwards, and the end of the bone is never at the central point of the stump. (*Velpeau, Nouveaux Elém. de Méd. Oper.* t. i. p. 505.)

It is curious to remark, however, that the thing which leads Mr. C. Hutchison to disapprove of the plan, is one which would be urged in its favour by Dupuytren, Roux, and some other surgeons, who actually take the precaution of never closing the lower angle of the wound, in order that whatever discharge occurs may find a ready outlet. (*Mém.* cit. p. 14.) Thus, Velpeau states, that the French surgeons prefer having one angle of the wound forward, the other backward, in order that fluids may have a ready outlet. (*Nouv. Elém. de Méd. Chir.* t. i. p. 509.; also *Dupuytren*, t. iv. p. 416.) As a general maxim, observes this very distinguished surgeon, the soft parts should be brought together in the direction of the lesser diameter of the stumps, if circular amputations have been performed; and so as to bring the bleeding surfaces of the flaps together, if flap-amputations have been done: the wound is to be brought together, with its line in the direction of the great diameter of the oval, if the oval, or oblique mode of amputation has been selected.

Mr. Alanson objected to the line of the wound being vertical, asserting that the cicatrix afterwards became situated immediately over the end of the bone, the pressure of which was very likely to make the part ulcerate. However, in St. Bartholomew's Hospital I have seen the edges of the wound occasionally brought together in the perpendicular direction, and capital stumps made in this manner. In a case in which I assisted Mr. Ramsden at Christ's Hospital, when an attempt was made to put up the wound in the common manner, the bone seemed to make considerable pressure against the skin, which did not happen, when the line of the wound was made in the other direction, which of course was immediately adopted. Mr. Hey has noticed this subject as follows: the integuments and muscles may be brought into contact by pressing either the anterior and posterior parts, or the sides of the thigh, together. The former method, by the gradual retraction of the posterior muscles, causes the integuments of the anterior part of the stump to cover more completely the extremity of the bone. The latter method causes the integuments and muscles to meet each other the more readily, and therefore is to be preferred, when the quantity of soft parts preserved is somewhat deficient. (*Pract. Obs. on Surgery*, p. 533. ed. 2.)

M. Malgaigne observes, that, whether the line of the wound be transverse, or perpendicular, the inconveniences are equal. The former plan leaves a *cul de sac* below, in which pus lodges; in the latter method, one angle of the wound is pressed against the cushion, which supports the stump. Perhaps, says M. Malgaigne, the oblique direction should be preferred. (See *Malgaigne, Manuel de Méd. Op.* p. 298.)

The plan of bringing the edges of the wound together after amputation, so that they may unite by the first intention, has received, for many years past, the universal approbation of British surgeons. It is their general practice, in the treatment of all incised wounds. It may be said to be the pride of English surgery; for in nothing does she display more convincingly her superiority. Baron Larrey, however, in cases of amputation, disapproves of the attempt to unite the wound by the first intention, and merely brings forward its edges somewhat towards each other with a piece of linen, that covers the whole of the wound, and has small holes cut in it for the passage of the discharge. (*Mém. de Chir. Mil.* t. iii. p. 379.) This piece of linen is supported with a moderately tight roller.

M. Roux, on his arrival in this country, wondered to see British surgeons so prejudiced in favour of union by the first intention, as to adopt it after all amputations. "*C'est pareillement abuser de la réunion immédiate que de l'appliquer en toute circonstance à la plaie qui résulte de l'amputation des membres. J'entends parler de l'amputation dans la continuité des membres, et plus particulièrement encore de l'amputation circulaire.*" (P 128. *Parallèle de la Chirurgie Anglaise avec la Chirurgie Française*, 8vo. Paris, 1815.) But M. Roux has curiously omitted to explain, in his book, what are the advantages of not bringing the edges of the wound together, and why he calls prejudice the partiality to a method, the superior efficacy of which is continually demonstrated in every hospital of London. He does not, indeed, presume to condemn the practice altogether; on the contrary, he allows it to be proper in certain cases; yet he contends that it ought to be confined within particular limits. (P. 130. See, also, *Mém. et Obs. sur la Réunion immédiate de la Plaie après l'Amputation, &c.* 8vo. Paris, 1814.)

In this tract, M. Roux proves most convincingly the benefits of union by the first intention, after amputation of the thigh by the circular incision; but, strangely enough, his prejudices hinder him from advising the practice to be extended to other amputations. He does not positively condemn it in the arm, though he thinks the method less necessary, because amputation there is less dangerous than in the thigh, &c. (P. 45.) To such futile reasoning is this author reduced by the unsoundness of his doctrine. He also deems the attempt at union by the first intention counterindicated, where limbs are amputated for injuries which violently contuse and crush the parts (p. 48.), and where the limb is much wasted. (P. 50.) In the latter condition, however, he thinks Desault's flap-amputation may be done, and an effort made to heal the wound by adhesion. In one case, he did this with success. (P. 51.) The opinions of Dupuytren on this subject lead him also to be an advocate for reform in the practice of aiming constantly at complete union by the first intention, after all amputations. He was for *un sage milieu*. The facts and arguments, which form the basis of his precepts, will be noticed with the subject of union by the first intention in the article *Wounds*.

Dubois has tried the plan with a success equal to that of the London surgeons. "The method is preferable," says Richerand, "to the old one, in whatever point of view it is considered. This union is more expeditious, a few days being sufficient for its completion. A woman, whose thigh I took off in 1810, was very well in a week, &c.—Besides the advantage of a quick cure, and such quickness is especially of great importance, where the patient has been much reduced, so that he would hardly be able to bear a long suppuration, union by the first intention has the recommendation of saving the patient from a great deal of pain, the flap of integuments with which the bleeding surface of the stump is covered, being much less irritating to the flesh than the softest charpie would be, &c.—Three years have elapsed since the publication of the third edition of this book. During this interval, I have performed more than a hundred and fifty amptutations, and the utility of immediate union has been more and more proved to me." (*Nosographie Chirurg.* p. 475. 477. ed. 4.)

But, notwithstanding these and other encomiums on the practice, Richerand, like other French surgeons, is not an advocate for it in certain cases; as, for instance, limbs shattered by gunshot wounds, or affected with hospital gangrene. Here he maintains that it hardly ever succeeds. (P. 478.) But, though it be true, that amputations after gunshot wounds do not generally heal so well as many other cases, it cannot be denied that they do sometimes unite more or less by the first intention; and why should not the chance be taken? It is productive of no danger; there is nothing better to be tried; and if it fail, what is the harm? Why, the wound will then heal by suppuration and the granulating process, just as soon as if the hollow of the stump had been filled with charpie, or left open; it will, in fact, heal in a way, which is less advantageous than union by the first intention, but which is the best which can now happen. The very cases, which Richerand condemns as unfit for union by the first intention, are those particularly specified as most favourable for it by Dupuytren (see *Leçons Orales*, t. iv. p. 419.); while Delpech is so convinced of the necessity of the perfect closure of the wounds, where hospital gangrene is prevailing, that in order to let this object be most completely fulfilled, he advices both ends of each ligature to be cut off close to the knot.

From what has been said, it appears that the practice of healing the wound by the first intention after amputation is less general in France than it is in England; a circumstance, which may perhaps be explained by the fact of its being much newer to the French than to us. Every improvement must encounter for a time the opposition of prejudice; but one, so important as that which we are considering, must at length prevail and meet with universal adoption. Our extraordinary partiality to union by the first intention arises from a conviction of its superior efficacy, and is a decisive proof of the goodness of English surgery in respect to wounds. The observations of MM. Roux and Richerand tend to prove, that they are not altogether unaware of its advantages, and they therefore recommend it for certain cases; but, their backwardness to extend it to all amputations is little in favour of the comparison, which they are so fond of making of French with English surgery. Even the eminent Dupuytren had great apprehensions about lodgments of matter, if union by the first intention were completely attempted; and, for the prevention of them, left the lower angle of the wound open, sometimes placing a tent in it, and always the ends of all the ligatures twisted into one cord, as already explained. This cord of ligatures serves to conduct the discharge out of the unclosed angle of the wound, and abscesses in the deep part of the stump are prevented. A great portion of the wound unites by the first intention; suppuration only takes place in the track of the ligatures, and, in general, as soon as these have been detached, it soon ceases. (See *Leçons Orales*, t. iv. p. 416.)

However, that stumps may fall into a state, in which the pressure of all plasters and bandages whatever should be most carefully avoided, and emollient poultices used, is a truth of which every surgeon of experience must be fully convinced. This happens whenever the parts are affected with considerable tension, inflammation, and swelling, or painful acute abscesses. There is also no utility in keeping the edges of the wound very closely compressed together when all chance of adhesion is past, and the parts must heal by the granulating process. My friend, Mr. Guthrie, after amputations, performed from necessity in parts not in a healthy state, as in most secondary amputations after compound fractures of the thigh, does not insist upon the edges of the wound being brought into close contact by sticking plaster, compress, and bandage. In these cases, he also recommends the bone to be sawn an inch shorter than usual, or than would be neeessary under other circumstances, in order to prevent its protrusion, and the ligatures to be cut off close to the knots, so as to lessen irritation. The integuments and muscles are to be brought forward, and retained so by a moderately tight roller, but not laid down against the bone. Some fine lint, smeared with cerate, or oil, is to be put between the edges of the wound; and a piece of linen and a Malta cross over it, supported by a few light turns of the roller. "In some cases," says Mr. Guthrie, "I have put one, and even two straps of plaster over the stump, to keep the edges approximated, without being in contact; and where the parts are but little diseased, this may be attempted; but if the stump becomes uneasy, they should be cut, and a poultice applied. When only a part of the stump has appeared to slough, I have found the spiritus camphoræ alone, or diluted with a watery solution of opium, applied with the lint, very useful." (*On Gunshot Wounds*, p. 104.)

The reasons which led Mr. Guthrie to incline to the plan of not bringing together the edges of the wound, in cases of this description, must be learned by reference to his own valuable work. His cases and arguments are entitled to serious consideration; and though they, as well as the observations of M. Roux (*Mém. sur la Réunion immédiate de la Plaie après l'Amputation*, 8vo. Paris, 1814.), leave me unconvinced of the usefulness of not bringing the edges of the wound together, immediately after the amputation of bad compound fractures, there are some of his observations, respecting the injurious effects of pressure in certain conditions of the stump, perfectly agreeing with my own sentiments. At present, I have never seen any case of amputation, in which I should not have thought the surgeon wrong, had he not brought the sides of the wound together directly, or within a few hours after the operation, so as to afford the chance of union by the first intention.

VARIOUS BAD CONSEQUENCES MAY FOLLOW AMPUTATION;

As, for instance, spasms of the stump, tetanus, hemorrhage, severe inflammation of the stump, abscesses and extensive sinuses, inflammation of the medullary membrane, necrosis (see *B. Phillips*, in *Lond. Med. Gaz.* for 1833—34, p. 189.), protrusion of the bone, phlebitis, and suppuration in internal organs and in various other parts of the body, hospital gangrene, neuromata, &c. Of these several complications, which may either interrupt cicatrization, or subject the patient to great and protracted suffering, or even lead to a fatal termination, some are common to many operations; others restricted to that which is now under consideration; some arise from external causes; others from internal. (See *Dupuytren*, *Leçons Orales*, t. iv. p. 425.) It is only necessary to enter into a part of these topics in the present place, because the others more properly belong to the articles HOSPITAL GANGRENE, NECROSIS, PHLEBITIS, STUMPS, SUPPURATION, and TETANUS.

SECONDARY HEMORRHAGE.

Bleeding, after the operation, is of two kinds in regard to the time when it occurs. The first takes place within twenty-four hours after the operation, and when the circulation has risen with the inflammatory fever. Hence an assistant should always be left with the patient, with directions carefully and repeatedly to look at the stump, and if any bleeding should arise, to apply the tourniquet, until further aid be obtained. In case no assistance can be spared for this purpose, as must frequently happen in country practice, the tourniquet should be left slackly round the limb, and the nurse, or patient himself, directed to turn the screw of the instrument, in order to tighten it in case of need. A slack tourniquet, left round the ring after amputation, cannot do harm, and its not having been ready in this way has cost many patients their lives.

This kind of hemorrhage has often been known to arise from the pressure of a tight bandage round the stump. As Monro observes, the circular turns of the bandage, when tight, must stop the return of blood in the cutaneous veins, and thus by making a greater resistance to the blood in the arteries, which anastomose with them, occasion the contracting power of the heart and arteries to dilate and force more blood into their other branches; but, these being cut in the amputation, will pour out their blood, and so hemorrhage is brought on. Making much pressure round the stump is highly deserving of reprobation; and whenever there is a universal oozing of blood, I would recommend the operator to be sure, that the circulation in the superficial veins is not impeded by the tightness of any bandage or tourniquet.

If the bleeding should not be from an artery of consequence, the application of linen dipped in cold water will sometimes check it, and the disagreeable necessity for removing the dressings and opening the wound may thus be avoided. But it often happens that the wound must be opened, and the bleeding vessel tied. This is a very painful proceeding; and when the dressings have been applied some hours, so that the stump has had time to inflame, nothing can exceed the suffering to which the patient is now subjected. Here we see the prudence of being particularly careful at first to tie every suspicious vessel.

A few years ago, directly after the ligature of the vessels, the stump was always closed and dressed. Such, indeed, is still the general practice. Dupuytren deviated from this custom by letting one or several hours elapse before he dressed the stump. The vessels having been secured, the patient was conveyed into bed again, with merely a single compress and slack bandage placed on the stump. Dupuytren's reasons for this practice are that, notwithstanding every possible attention, hemorrhage will frequently take place shortly after operation, and compel the surgeon to remove the dressings; and that these often conceal the bleeding, till it has gone on to a fatal extent. Arteries are frequently prevented for a time from throwing out blood by the patient's syncope, or mental depression; but, in two or three hours they begin to bleed profusely, on the circulation recovering its force. From the period when Dupuytren commenced the custom of deferring the dressing for a time, no consecutive hemorrhage of this kind occurred in any of his patients. (See *Leçons Orales, &c.* t. iv. p. 412.) The regular dressing of stumps is also deferred by Mr. Liston for six or eight hours, or till all oozing has ceased; merely lint wetted with cold water being at first placed over the wound. (See *Liston's Elem.* part iii. p. 368.)

The second sort of hemorrhage, after amputation, arises from ulceration of arteries, and may occur a few hours, or even some weeks or months after the operation, when all the ligatures have come away, and the patient seems nearly well. Two such cases are related by Mr. Bromfield. (Vol. i. p. 307.) J. L. Petit saw an instance in which the hemorrhage came on twenty days after amputation of the thigh very high up; and Baron Dupuytren refers to an example in La Charité, where the bleeding took place two months after an amputation of the leg, from a fistulous opening in the stump, in consequence of ulceration of one side of the popliteal artery. (See *Leçons Orales, &c.* t. iv. p. 426.) Now that the plan of covering the stump with sound skin is adopted, this kind of bleeding is less common than formerly. When the bleeding vessel is large, there is no chance of putting the patient out of danger, except by cutting down to the vessel, and tying it. The trunk of the vessel, however, may sometimes be more conveniently tied than the bleeding branch itself.

Mr. Hey mentions a particular sort of hemorrhage, after the operation: "I have seen," says he, "a few instances of the integuments becoming so contracted after the operation, as to compress the veins just above the extremity of the stump, and bring on after some hours a copious hemorrhage. When it has appeared clear to me that the hemorrhage was venous, I have made a division of integuments on one side of the thigh, sufficient to remove the stricture, and this method has immediately suppressed the hemorrhage." (P. 530. edit. 2.)

I have never met with a case, where hemorrhage was unequivocally produced by a contraction of the integuments. Dr. Hennen states, that he had seen only one example, and it was successfully treated by loosening the bandage, and moistening the dressings with cold water. (*On Military Surgery*, p. 264. ed. 2.) Here I infer, from the mode of relief, that the cause was not the pressure of the integuments, but that of the roller on the veins.

In Mr. Guthrie's practical work, there are some excellent remarks on those hemorrhages, which, in an irritable and sloughing state of a stump, frequently take place from the small branches, or from the main trunks of the arteries, in consequence of ulceration. It is (says he) not always easy to discover the bleeding vessel, or, when discovered, to secure it on the face of the stump; for, as the ulcerative process has not ceased, and the end of the artery, which is to be secured, is not sound, no healthy action takes place. The ligature very soon cuts its way through, or is thrown off, and the hemorrhage returns; or some other branch is opened, and another ligature is required, which is equally uncertain; and, under this succession of ligatures and hemorrhages, the patient dies. Here, cutting down to the principal artery, in preference to another amputation, has often succeeded; but, under other circumstances, it fails, and amputation becomes ultimately necessary. At the same time it is allowed that this operation may also fail. On the whole, Mr. Guthrie professes himself to be an advocate in most cases for tying the artery in the first instance; and if this proceeding should not answer, he would then amputate. However, the practice of taking up the artery, he thinks, should not be adopted indiscriminately, the doctrines of aneurism not being here applicable, because there is a wounded vessel, with an external opening. "In the thigh, the operation is less certain than in the arm, and especially if it is not the main artery that bleeds; for, the branch from which the hemorrhage proceeds may come from the profunda, and tying the artery in the groin on such opinion would be doing a serious operation, and one which probably would not succeed; for, the anastomosing branches would restore the circulation in the stump in a short time, and again establish the bleeding. If it is the femoral artery that bleeds, and the ligature is applied high, it is very liable to a return of hemorrhage. To obviate these difficulties, the part from which the bleeding comes should be well studied, and the shortest distance from the stump carefully noted at which compression on the artery commands the bleeding; and, at the spot, the ligature should be applied, provided it is not within the sphere of the inflammation of the stump." (*On Gunshot Wounds*, p. 105, 106.) Thus far the advice seems to me correct and valuable; but, where the hemorrhage could be restrained by taking up the artery in the groin, though not lower down, I doubt the propriety of preferring amputation to this other less severe operation, provided the efficiency of a ligature above the profunda be proved, in the manner

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judiciously recommended by Mr. Guthrie, viz. by means of pressure.

The following is the counsel offered by Mr. Hey: "When we are under the necessity of amputating a limb that has suffered great contusion, though the operation is performed upon a part apparently sound, the wound sometimes becomes sloughy and ill-conditioned. No good granulations arise to cover the extremities of the arteries; but the ligatures cut through these vessels, or, becoming loose, cease to make a sufficient pressure upon them, and hence repeated hemorrhages ensue. This is a dangerous state for a patient; for, if the vessels are taken up afresh with the needle, the hemorrhage will now and then return in the course of two or three days. In such cases the application of dry sponge, cut transversely, as directed by Mr. White (*Cases in Surgery*), has been found singularly useful, and has saved the life of the patient. But a constant pressure must be kept upon the pieces of sponge, by the fingers of a succession of assistants, till granulations begin to arise upon the stump, and the prospect of future hemorrhage disappears. This method is of the greatest importance after amputation on the thigh, or leg, where the great vessels are deeply seated. In the arm, above the elbow, where the vessels are more superficial, the great artery may be taken up, with a portion of muscular flesh, above the surface of the stump, by making first an incision through the integuments. My colleague, Mr. Logan, has done this twice within the last year, with complete success, when repeated ligatures, applied in the usual way, had failed.

"In the morbid sloughy state of the stump, above mentioned, the application of lint, soaked in a liquid, composed of equal quantities of lemon-juice and rectified spirit of wine, has been found very advantageous, and has caused it to put on soon a healthy aspect." (P. 536, 537. edit. 2.)

Inflammation and suppuration in the arteries of a stump have a particular tendency to loosen the clot in them, and thus produce secondary hemorrhage. Ulceration of an artery may also be excited by an inflammation, which keeps up suppuration directly around the vessel. At the period, when the ligatures are expected to be detached, the utmost vigilance should always be exerted to guard the patient from the risk of secondary hemorrhage. (See *Dupuytren, Leçons Orales*, t. iv. p. 428.)

These kinds of secondary hemorrhage, as Baron Dupuytren justly observes, are much more difficult to stop, than such as come on immediately or soon after amputation. The cellular tissue is deprived of its natural suppleness and flexibility; and is so thickened and changed that every fresh ligature cuts through it. Generally, also, the direct application of a ligature to the bleeding part of the arteries is impracticable; because, as the coats of the vessel adhere to the neighbouring textures, it either cannot be taken hold of, or is torn with the least effort being made with the forceps to draw it out. As for permanent compression, this is frequently ineffectual, and attended with too much pain. Under these circumstances, it is better to expose and tie the principal artery at some distance above the stump. (*Op.* vol. i. cit. p. 429.) Thus, in a case of secondary hemorrhage after amputation of the leg, where the bleeding returned notwithstanding the repeated application of the ligature, and even the actual cautery, Baron Dupuytren took up the femoral artery in the upper third of the thigh, and the result was perfectly successful. The same practice has succeeded with others. Mr. Liston informs us, that he has had recourse to it in many cases, and uniformly with success. (See *Elements*, part iii. p. 371.) This gentleman notices a kind of secondary hemorrhage, which does not consist in an arterial and rapid flow, but in a slow and continual oozing from the dark ulcerated cavities round the end of the bone. This case is ascribed by Mr. Liston to diseased action in the cancellated texture of the bone; and the treatment which he recommends is that of removing the coagula, filling the cavity with lint, and applying firm pressure. (See *Liston's Elem.* part iii. p. 372.)

On Protrusion of the Bone.

It appeared to M. Louis, that this disagreeable consequence may generally be prevented by taking care to divide the loose muscles first, and after their complete retraction, unresisted by any band or tourniquet, by observing to divide with a bistoury the muscles which adhere to the bone; namely, the cruralis, the vasti, and the adductors. By this method, the bone may be sawn three finger-breadths higher than it could be, if no attention were paid to beginning with the division of the loose muscles, and concluding with that of others attached to the bone. M. Louis argues, that the protrusion of the bones will never take place, so long as they are immediately encompassed with the fleshy substance of the muscles: this proposition is incontestable. But, with regard to another assertion that, whether the skin, saved by the operation, be long or short, is a circumstance that has no influence in preventing or promoting the protrusion, I believe that this part of his statement is less correct. (See *Mém. sur la Saille de l'Os après l'Amputation*, in *Mém. de l'Acad. de Chirurgie*, tom. v. p. 273. edit. in 12mo.) According to my own observation, one of the best founded arguments in favour of flap-amputation of the thigh is, that this method is attended with scarcely any risk of a subsequent protrusion of the bone.

As Mr. Guthrie has observed, a protrusion of the bone, after sloughing of the stump, or other accidental circumstances, will sometimes happen, without any fault on the part of the operator; but he thinks, it may almost always be prevented by attention to the following rules:—1. To leave the integuments attached to the muscles, instead of turning them back. 2. When the muscles are cut through in a slanting direction, upwards and inwards, or even directly downwards, to separate them from the bone, so that it may appear at the bottom of the cone as a depressed point. 3. To cut the bone short, and to keep the thigh constantly bandaged from the trunk during the cure, so as to prevent the retraction of the muscles. If a surgeon find, directly after the operation, that the bone cannot be well covered, he should immediately saw off as much more of it as will reduce it to its proper length. The error may be remedied at this moment with very little inconvenience, in comparison with what must afterwards be encountered, if the opportunity be neglected. (*On Gunshot Wounds*, p. 109.) This last piece of advice perfectly agrees with the view which I entertain of the subject. For some useful directions how to bandage and support the soft parts with adhesive plasters, with the view of counteracting the tendency of the bone to protrude, I refer to some observations by Mr. Wright. (See *Bromfield's Chir. Cases, &c.* vol. i. p. 177.)

Having explained, that the surest way of preventing the evil is either to perform the flap-amputation, or, if the circular, to save a sufficiency of muscle, especially of that muscular substance which is naturally most near and adherent to the bone, I shall next speak of the mode of relief.

When the end of the thigh-bone protrudes, it of course hinders cicatrization, and becomes itself affected with necrosis. By the process of exfoliation, the dead portion of bone is sometimes thrown off, and a cure follows. But, in general, this desirable change is extremely tedious, and the result uncertain; because it frequently happens, that, after the piece of bone has separated, the rest yet projects too much, and the stump still continues too conical to heal firmly enough to be capable of bearing the pressure of a wooden leg. When, however, the end of the bone forms only a slight projection, and the stump is not too conical, it is always best to leave nature to throw off the redundant exfoliating portion. In the opposite circumstances, the removal of all such parts of it as cannot be covered by the integuments, is the best practice, and, if well executed, will effect a cure.

The second operation is exceedingly unpleasant to the surgeon, because patients are apt to suspect, and not without reason, that the first was not properly managed. Let me therefore repeat, that the surest way of avoiding the evil is to cut the deep muscles, rather higher than the superficial ones, as inculcated by M. Louis, by which means the bone will certainly lie within the level of the surface of the divided flesh. If the soft parts are found to be deficient, let another piece of the bone be exposed and sawn off at once, before the patient is removed from the operation table.

The second performance of amputation is a still more severe and unpleasant operation; yet, as Dr. Hennen has explained, it sometimes becomes necessary for osteosarcoma, extensive necrosis, abscesses of the medulla, unsuspected fissure, phagedæna, or great protrusion of bone, with an extensively diseased periosteum, where the powers of nature are inadequate to the cure. "If the general health is not impaired, and the flesh does not peel off from the bone, as if it were boiled, the efforts of nature may be trusted to, aided by proper bandaging, and, in some cases, by the employment of the saw; but, when restless nights, intense pain, flushings, and irregular bowels, with great tumefaction and hardness of the stump, take place, indicating approaching hectic, and there is evidence of an irregular action of the parts, osseous matter becoming deposited, and forming a distinct tumour around the stump, our best plan will be to operate again near the trunk." (*Principles of Military Surgery*, p. 266. ed. 2.)

OF NEUROMATA AFTER AMPUTATION.

Sometimes amputation has been found necessary a second time, in consequence of a morbid protuberance of the nerves of the stump, — a change noticed by Molinelli, Morgagni, Lower, Arnemann, and Prochaska, and always attended with excruciating pain and great irritability of the part, and sometimes with retraction of the skin and protrusion of the bone. According to Mr. Liston, neuromata are more frequent after amputation of the arm and forearm, than other amputations. The disease seems to him, however, to be less common than formerly, which he refers partly to flap-amputations having been more extensively adopted, and partly to the method of tying arteries, so as to include nothing else in the ligature. In the forearm I have never seen a neuroma follow amputation, and yet almost all the operations were circular. Sir Astley Cooper, in his Lectures, relates one instance of such a stump high up the arm, where, upon examination of the part near the axilla, a tumour was felt, which, when touched, made the patient jump, as if he had been electrified. In this case, as the bone protruded, amputation at the shoulder was performed. In another example, where a leg-stump was in a painful irritable state from a similar cause, Sir Astley Cooper effectually relieved the patient by removing the diseased end of the posterior tibial nerve. This plan should always be preferred to amputation, when it presents any chance of being efficient. In a third instance, amputation was repeated at the patient's desire, and the nerves were found enlarged, forming a ganglion which partly rested upon the extremity of the bone. Such a degree of irritation had been produced by it, that no part of the stump could be touched without exciting a kind of electric shock. In a case that occurred in the Middlesex Hospital, amputation of the thigh was performed a second time, in consequence of the first stump being thus diseased. A complete ganglion, or plexus of nerves, was found closely adhering to the removed portion of bone, having almost the appearance of cartilage. The os femoris was of an unusually small size, but the linea aspera larger than natural. (See *Lancet*, vol. i. p. 115.; vol. iii. p. 192.) In the same hospital, Mr. Mayo also amputated at the hip, on account of the extreme sufferings caused by a diseased state of the nerves of a thigh stump. (See NEUROMA.) For some observations on the changes which occur in stumps after cicatrization, see STUMPS.

The following works may be consulted for information on diseases of the bones of stumps: *Bonn*, Thesaurus Ossium Morborum, Amst. 1788; *Weidmann*, De Necrosi Ossium, Francof. 1798; *Macdonald*, De Necrosi ac Callo, Edinb. 1799; the above mentioned Essays of M. *Louis*; *Léveillé*, Sur les Mal. des Os après l'Amputation, Mém. de la Société d'Emulation, t. i. p. 148.; *Van Hoorn*, De iis, quæ in partibus membri, præsertim osseis, amputatione vulneratis, notanda sunt, Lugd. 1803; *Roux*, De la Résection des Os Malades, Paris, 1812; Mém. de Physiologie, &c. par *Scarpa*, et *Léveillé*, Paris, 1804; *B. Phillips* on Inflammation of the Medullary Membrane after Amputation, Lond. Med. Gaz. 1833-34; *G. Langstaff* on the Healthy and Morbid Conditions of Stumps, in Med. Chir. Trans. vol. xvi.; *Crookes* on a Neuralgic Affection of Stumps, Lond. Med. Gaz. 325.

SPASMS OF THE STUMP

Constitute another afflicting occurrence, as they put the patient to the greatest agony, tend to cause a protrusion of the bone, or sugar-loaf stump, and, in some cases, extend to the whole body, and ultimately prove fatal. But, this unfortunate affection, which was rather frequent after amputations performed in the ancient manner, is infinitely less so, after the modern improved plans of operating, tying the vessels, and dressing the wound. When, however, it does occur, the stump must be kept from starting, by binding it down with a broad band, placed across it a little way above the wound. The flesh is to be properly supported with a bandage applied from the pelvis downwards, and opium and the camphor mixture should be liberally exhibited. (*Encyclopédie Méthodique, Partie*

Chir. t. i. p. 93. *Latta's Surgery*, vol. iii. &c. Also *Liston's Elements*, part iii. p. 395.)

Flap-Amputation of the Thigh.

Although the majority of surgeons in England and France (see *Velpeau, Nouv. Elém.* t. i. p. 510.) regard the operation by a circular incision as the most eligible under ordinary circumstances, no doubt can exist about the preference which should be given to amputating with a flap, in particular examples. The choice, Dr. Bushe conceives, ought to depend on the state of the limb and nature of the malady. "One surgeon is so devoted to the double circular incision, that he performs no other (method), though his coadjutor in the same hospital is a bigoted to the double-flap operation, and never amputates but after this manner. But the unprejudiced practitioner will look to the nature of the case, and adjust means accordingly." (*Lancet*, No. 246. p. 204.) Notwithstanding the profession of this doctrine, however, Dr. Bushe is in reality very partial to flap-amputations, affirming that there is only one part, viz. the upper third of the leg, where he would recommend the double circular incision to be preferred. (*Op.* cit. p. 207.) At the same time, he confesses that when the arm is much emaciated, and flaccid, Dupuytren's mode, with a single circular incision, is that to which he has himself given the preference. He admits, also, the frequency of tedious suppuration and sinuses after flap-amputations, which evils, however, he ascribes to the fault of making the flaps too long. (P. 206.) Flap-amputation of the thigh occupies less time than the circular method, and, I believe, has the important advantage of being less exposed to the danger of a protrusion of the bone. Hence, whenever any reasons exist in the state of the parts, or the constitution, for apprehending that disagreeable occurrence, it should be preferred. An experienced military surgeon informs us, that, in the first years of his practice, he performed several amputations by the double incision, strictly according to the precepts of Sabatier, Desault, Pelletan, and Pott, but had the mortification to have three cases in which the bone protruded, though the greatest circumspection was used in the operation and after-treatment. Hence he was induced to make trial of the flap-amputation; and although he imitates O'Halloran in not attempting to bring the flaps close together for the first six or eight days, he reports that the stump is generally healed in twenty or thirty days, and exfoliations rarely happen, on account of the bone being so well covered. In short, he says, that this method is to be preferred to all others. (*J. B. Paroisse, Opusc. de Chir.* p. 185—203. Paris, 1806.) Mr. Syme also states, that though the flap-amputations seen by him have been numerous, he has never met with an instance of the bone protruding, or exfoliating after them. (*Ed. Journ.* vol. xiv. p. 38.)

Although surgeons differ on the question, whether flap-amputation of the thigh ought to be preferred, as the general practice, Desault's, or rather Vermale's mode of operating, has certainly obtained the sanction of many respectable names. In Guy's Hospital, flap-amputation of the thigh seems now to be mostly preferred. The operation has been for many years past adopted by my friend Mr. Vincent in St. Bartholomew's Hospital; and it is the plan which is always followed by Mr. Liston in the North London Hospital. "According to the point of removal (says he), the direction of the flap varies. If, in operating high in the limb, the flaps be made laterally, there will be imminent risk of the bone protruding through the upper part of the wound; for the patient uniformly raises the stump towards his abdomen. No antagonist muscular power is left to oppose the action of the muscles inserted into the trochanter minor, and the elevation of the stump is involuntary: it always occurs to a remarkable extent in young persons. On this account, anterior and posterior flaps are here preferable to the lateral; for then the more the stump is raised the better is the end of the bone covered—the anterior flap folding over it. Transfixion is, therefore, made horizontally, and the posterior flap should be a little longer than the anterior. But, in the lower part of the limb, lateral flaps are not only not liable to the same objection, but preferable to the anterior and posterior. In the neighbourhood of the knee-joint, the soft parts consist almost entirely of ligamentous tissue on the fore and back part, and proper cushions can be obtained only from the sides. Transfixion is therefore made perpendicularly. Thus the bone will be well covered by parts likely soon to adhere," &c. (See *Liston's Elements*, part iii. p. 394.)

By Mr. Guthrie, the flap-operation is considered preferable to the circular incision at the upper part of the thigh, "as it permits the head of the bone to be removed, if found necessary, allows it to be examined and cut shorter with greater ease, and makes a much better covering afterwards." (*On Gunshot Wounds*, p. 200.)

In military surgery, flap-amputation of the thigh is often advantageous, because all the flesh on one side of the limb is frequently torn away, or left in so terribly a mangled state, as to be unfit for making a covering for the end of the bone. Here a flap, sufficient to cover the whole face of the stump, should be saved from the sound flesh on the other side of the limb. When the surgeon chooses the flap-amputation, not from necessity, as under these last circumstances, and the flesh is sound all round the member, the best way is to save a flap on each side of the limb, by making two semicircular cuts, the convexities of which extend in a parallel manner forwards, and the terminations of which meet at the upper and lower surfaces of the limb. The skin is not to be at all dissected from the muscles, which are to be obliquely divided as high as the base of the flap on each side. However, though this is the best plan, particular cases may require a flap to be made from the anterior, or even the posterior side of the thigh. The latter method should never be followed, but from necessity. (See *Hey's Pract. Obs. in Surgery*, p. 531. ed. 2.)

According to Mr. Guthrie, the difference between the flap-operation, at the upper part of the thigh, and that at the hip, consists in its being done lower down, and in the flaps being saved more immediately from the external and internal sides of the thigh, the inner flap being the largest, in order to prevent the inconvenience which might arise from the external one being tightly stretched over the end of the bone. For the same reason, Mr. Guthrie also recommends the bone to be sawn off close to the lesser trochanter, even when the nature of the injury would allow of its being left an inch longer. (*On Gunshot Wounds*, p. 200.)

In the flap-amputation of the thigh, as originally practised by Vermale, the operator takes hold of the soft parts with his left hand, and draws them more or less away from the bone. He then introduces a long sharp-pointed knife down to the anterior surface of the femur, a few lines below the place where it is intended to apply the saw. The point is then conveyed close round the outer side of the bone, and pushed through the skin at the point of the back of the thigh exactly opposite that of its entrance. By cutting from above downwards, and from within outwards, the surgeon now forms the external flap, which should be three or four inches in length. It is to be held upwards by an assistant. The point of the knife is next brought to the front angle of the wound, and, while the soft parts are drawn inwards, it is to be carried close round the inner side of the femur, and pushed out at the posterior angle of the wound, without injuring the skin there, a second time. In this way a second flap is formed, of the same shape and length as the first. No retractor is necessary in this mode of amputating. Velpeau prefers making the external flap first, for two reasons: first, because the soft parts being less bulky on this side, it is proper to begin with saving a sufficiency of them, so that the flap may be equal in size to the other; and, secondly, because the femoral artery is not cut till the moment when the flap is completed, and the vessel may then be instantly secured without any previous pressure being made upon it in the groin. (*Velpeau, Nouv. Elém. de Méd. Opér.* t. ii. p. 511.) Flap-amputation of the thigh is varied by different operators, some making anterior and posterior flaps; and others, like Langenbeck, not transfixing the limb, but cutting down to the bone from without inwards. Transfixion seems to me to be recommended by the power, which it gives the surgeon of making with rapidity a capital flap.

Flap-amputation of the thigh, after the manner of Vermale, is preferred by Klein, Lisfranc, Liston, Syme, and many other modern surgeons. (See *Edinb. Med. and Surg. Journ.* vol. xiv. 36—46, &c.) Of seven cases, in which Klein adopted this method, the greater number were healed in ten days, and the rest in three weeks; and this success determined him in future always to practise it. After this mode, he finds there is no danger of the muscles retracting themselves, and the end of the bone protruding, even though the patient be transported from one place to another. With respect to the occasional difficulty of taking up the obliquely cut vessels, Klein admits this objection, but thinks that it equally applies to Alanson's method. He lays great stress on the utility of giving due support to the flaps with compresses and a roller. (See *Practische Ansichten der bedeutendsten Chirurgischen Operationen*, p. 35—38. 4to. Stuttgart, 1816.)

If the state of the integuments did not admit of two flaps being made, a single one might be formed on the inner or outer side, the front, or the back part of the limb, according to circumstances. MM. Hello and Fouilloy commonly prefer making only one flap from the anterior soft parts; a method which seems to M. Velpeau to have the advantage of more certainty, than any other plan, of preventing the protrusion of the bone, because the flap is kept over the whole extent of the wound by its own weight. Yet, he is disposed to believe the circular method, when well performed, preferable to all these modifications, which he would employ only as exceptions to it. (*Nouv. Elém. de Méd. Opér.* t. i. p. 512.)

In one instance, where a ball had broken the upper third of the femur, and mortification had spread so far towards the great trochanter and buttock, that it was impossible to operate, except by the flap-operation, or by taking the head of the bone out of the joint, Klein made a broad flap six inches long at the inner and upper part of the thigh, and then he cut the soft parts straight across just below the great trochanter, so as to make this wound meet the termination of the incision, by which the inner flap was formed. This patient got perfectly well in three weeks (*Op.* cit. p. 39.); and so did another very similar case, operated upon by the same gentleman. (P. 43.) Where the bleeding is considerable, the femoral artery and profunda should be tied previously to sawing the bone; but, if the vessels are well commanded by the pressure, the sawing ought to be first completed.

In the middle of the thigh, Lisfranc prefers amputating with two lateral flaps; pressure is made on the femoral artery as it passes over the brim of the pelvis; and the vessel is tied immediately the inner flap is formed. Lisfranc makes the flaps with a long narrow two-edged knife, which is introduced through the limb on each side, and then cuts obliquely outward and downward with it; but, I think Mr. Syme is right in recommending the knife used by Mr. Liston, and the back of which is thin and blunt, except for an inch from the point. (*Ed. Med. Surg. Journ.* vol. xiv. p. 37.) Mr. Hey likewise preferred a knife with a blunt back, lest the vessels should be cut with it in a way that would render the securing of them troublesome.

Amputation below the Knee.

In treating of amputation of the thigh, I have remarked, that as much of the limb as possible should be preserved. The longer it is after the operation, the stronger and more useful will it be found. But, when the leg is to be amputated, the operation is usually done a little way below the knee, even though the disease, for which the limb is removed, may be situated in the foot, or ankle, and would allow the operation to be done much further down. The common practice is to make the incision through the integuments, just low enough to enable the operator to saw the bones, about four inches below the lowest part of the patella. This is termed the place of election. About six inches below this point is generally an eligible place for the first circular cut through the skin. This plan is followed, in order not to deprive the stump of that power of motion, which arises from the flexor tendons of the leg continuing undivided. It is alleged also as a reason for this mode of proceeding, that it is quite sufficient to preserve a few inches of the leg, in order to afford the body a proper surface of support, in walking with a wooden leg; whereas, if a larger portion were saved, the superfluous part would be a great inconvenience both in walking and sitting down, without being of the smallest utility in any respect whatever. However, as I shall presently notice, experience proves that where, according to these maxims, an injury, or disease, would dictate the performance of amputation above the knee, the practice of amputating below this joint, but much higher than is generally sanctioned, may be followed with advantage.

The tourniquet should be applied to the femoral artery, about two thirds of the way down the thigh, just before the vessel perforates the tendon of the adductor magnus. This place is more convenient than the ham, where it is difficult to compress the vessel against the bone. The patient is to be placed upon a firm table, as in amputation of the thigh; the sound limb fastened with a band to the nearest leg of the table; and the leg which is about to be removed, being properly held by one assistant, while the integuments are drawn upward by another, the surgeon, with one quick stroke of the knife, is to make a circular incision through the integuments all round the limb. Some recommend the operator to stand on the inside of the leg, in order that he may be able to saw both bones at once. This is the old manner, which is still very generally followed. Many suppose that it diminishes the chance of the fibula being splintered, which is completely divided rather sooner than the tibia. But splintering the bones generally arises from the assistant depressing the limb too much, or the surgeon pressing too heavily on the saw. If this mismanagement were to occur, it would be difficult to explain why the tibia should not be splintered instead of the fibula, when a certain thickness of it had been sawn through. Le Dran long ago remarked, that the surgeon might deviate from this custom without danger, and even sometimes with advantage. At the same time, it must be admitted that, if the surgeon prefer standing on the inside of the limb, there is no objection to it at the time of using the saw; but, before this period, in amputating the right leg, there is great inconvenience in having the left hand next to the wound, as is the case when the surgeon stands on the outside of the right limb. Hence some surgeons cut the soft parts of the right limb while they stand on the outside of the limb; and having done this part of the operation, they proceed to the other side of the member for the purpose of applying the saw. I believe that no particular reason exists against sawing the two bones together, yet in such a manner as to let the fibula be first divided entirely through. The advantage of fixing this bone against the tibia by the pressure of the hands of the assistants, while the surgeon is sawing it, is a circumstance which influences many writers to commend the latter plan. Graefe, who prefers the true flap-operation, does not think it advisable for the surgeon to stand on the inside of the limb in his method of operating, because, when the knife is introduced through the muscles of the calf, its point would be apt to go between the two bones. (*Normen für die Abl. grösserer Gliedm.* p. 130.) And, instead of the old maxim, that the operator should always stand on the outer side of the limb, Velpeau considers that it would be a better rule to let the surgeon's position be such as will constantly enable him to take hold of the limb below the knee with his left hand. This is the plan, to which he has for a long while conformed. (*Nouv. Elém. &c.* t.i. p. 484.)

A circular cut having been made through the integuments, about two inches below the place where it is intended to saw the bones, the next object is to preserve skin enough to cover the front of the tibia, and the part of the stump, corresponding to the situation of the tibialis anticus, extensor longus pollicis pedis, and other muscles, between the tibia and fibula and those covering the latter bone. Throughout this extent there are no bulky muscles which can be made very servicable in covering the end of the stump, and consequently the operator must take care to preserve sufficient skin in this situation, by dissecting it from the parts beneath, and turning it up.

On the back part of the leg, on the contrary, the skin should never be uselessly detached to a great extent from the large gastrocnemius muscle, which, with the soleus, will here form a sufficient mass for covering the stump. However, the experience which I had in the army taught me the truth of a remark made by Graefe, that, in forming the posterior flap of muscle, it is a matter of the highest importance to let the integuments be somewhat longer than it; for, otherwise, when it is turned forward, as it must be for the purpose of covering the ends of the bones, its front edge will be left uncovered by integuments, which, being the outermost, describe a greater circumference than the deeper muscular flap. (*Normen für die Abl. grösserer Gliedm.* p. 131.) My friend, Mr. Langstaff, also bears witness to the same fact, where he observes, "When the circular incision has been employed, I have seen the woeful effects that have ensued from the union having been prevented by leaving too much muscle; and it is injurious by impeding the adhesive process, the absorbents having to remove the unnecessary parts off the muscles, before this process can be established." (*Langstaff on the Healthy and Morbid Conditions of Stumps, Med. Chir. Trans.* vol. xvi. p. 152.) I was fully convinced of the truth of these observations, by two amputations which were done by myself, one in the neighbourhood of Antwerp, in 1814, and the other at Brussels, the day after the battle of Waterlöo. Yet Graefe, who performs the flap-amputation, strictly so called (that is to say, the operation in which a flap of skin, corresponding in shape to the flap of muscle, is preserved), does not himself detach the skin from the muscles of the calf at all, but, at the time of making the incision in that situation, directs one assistant to pull up the integuments, while another bends the foot as much as possible, which manœuvres have the effect of letting the muscles be cut rather shorter than the skin. Unfortunately, however, in many cases, the very nature of the disease, or injury, for which the operation is performed, would not admit of these proceedings. Nor, in a very muscular limb, would they be likely to suffice, as Graefe himself confesses, since, in such cases, he recommends the use of a knife bent laterally, for the purpose of excavating, as it were, the thick muscular flap, as the incision is made. (*Op.* cit. p. 134.) In the common method, with the circular incision, I am disposed to think it best, therefore, when the calf is bulky, to let a small quantity of skin be detached and saved at the back part of the leg, so that there may be a certainty of having enough to cover well the extremity of the divided gastrocnemius. As soon as the skin has been separated in front, and on the outside of the leg, the surgeon is to detach the skin from the calf for about an inch; and having reflected or drawn this preserved portion out of the way, he is to place the edge of the knife close to the edge of the retracted or reflected skin at the back of the limb, and cut obliquely upwards through the muscles of the calf, from the inner edge of the tibia quite across the fibula, supposing the operator to be on the outside of the right leg, and that it is this member which is undergoing removal. In performing this last incision, as M. Louis well observes, it is essential to incline the edge of the knife obliquely upwards. Thus, the skin will be longer than the muscles, and the cure accelerated. (*Mém. de l'Acad. de Chir.* t. v. edit. in 12mo.)

In the leg, the necessity of dissecting the skin from the subjacent parts is acknowledged to be greater than in the thigh: thus, Mr. Guthrie says, "As the attachment of the skin to the bone will not readily allow of its retraction, it must be dissected back all round, and separated from the fascia, the division of which in the first incision would avail nothing, from its strong attachment to the parts beneath." (*On Gunshot Wounds*, p. 220.) In dissecting the skin, however, a much greater detachment of it should be made at the front and outer part of the limb than at the opposite points, as already explained.

The flap, formed of the integuments and muscles of the calf, is then to be held back by one of the assistants, while the surgeon completes the division of the rest of the muscles, together with that of the interosseous ligament, by means of the catling, a kind of long, narrow, double-edged knife.

In amputating below the knee, very particular care must be taken to cut every fasciculus of muscular fibres, before the saw is used. Every part, except the bones, being divided, the soft parts are next to be protected from the teeth of the saw by a linen retractor, made with two slits to receive the two bones, care being taken to let the unslit part be applied to the muscles of the calf, as particularly advised by Graefe. (*Op.* cit. p. 146.)

Reckoning from before backward, the arteries requiring ligatures are — 1st, The anterior tibial, which lies close to the nerve, and in front of the interosseous ligament. 2dly, The posterior tibial with the nerve on its fibular side. 3dly, The peroneal: both these arteries being situated behind, between the soleus and the deep stratum of muscles, — the posterior tibial behind the external edge of the tibia, on the posterior surface of the flexor communis digitorum pedis, and the tibialis posticus; the peroneal behind the fibula, amongst the fibres of the long flexor of the great toe. 4thly, Sometimes two or more branches in the calf, termed sural. 5thly, Now and then the nutrient artery of the tibia. Frequently the anterior tibial artery retracts so far that it cannot be taken up, without first dividing the soft parts concealing it. The occurrence is ascribed by M. Ribes to the double curve which the artery describes to get in front of the interosseous ligament; by M. Gensoul, to the retraction of the artery exceeding that of the muscles which adhere to the bone; and by M. Sedillot, to the irregular division of the soft parts between the bone. (See *J. F. Malgaigne, Manuel de Méd. Opér.* p. 289.) Hence, he recommends the incision through the soft parts in the interosseous space never to be commenced, until the exact point where the bones are to be divided has been determined. A transverse cut is now made through the periosteum, on the inner surface of the tibia; and, supposing the operator to be standing on the outside of the limb, he next applies the edge of the knife, with the point downwards, to the outer side of the fibula, at the same height; and drawing it towards himself, cuts the peronæus longus, the extensor digitorum communis, the tibialis anticus, and at the same time the anterior tibial artery and interosseous ligament. The divided soft parts are gently drawn downwards, the point of the knife passed into the interspace from behind, and the division of the fleshy fibres in this direction completed by directing the knife towards the tibia and fibula. I am of opinion that the objection made by M. Malgaigne to the part of M. Sedillot's plan, which consists in cutting the bones and muscles on the same level, is well founded; viz. the muscles will always retract in some degree, and leave the bone projecting.

When the soft parts have been cut, the bones sawn, and the arteries tied, the wound is to be closed by bringing the flap of skin over the front and external part of the stump, so as to meet the flap composed of the gastrocnemius, soleus, and integuments on the opposite side. This should be done without letting any tight strap of plaster press the skin against the sharp edge of the tibia; a serious and hurtful practice, which has often occasioned ulceration and sloughing of the integuments, and protrusion and necrosis of the bone. It is this danger which leads Mr. Guthrie to prefer closing the wound vertically, or nearly so, and applying the adhesive straps from side to side. (*On Gunshot Wounds*, p. 221.) I think, however, the above mode of operating almost necessarily requires the wound to be closed, so as to form a line, extending in a direction from the tibia to the fibula, or in the direction of the greatest osseous diameter of the limb, as generally preferred in France. (See *Richerand, Nosogr.*; and *J. F. Malgaigne, Manuel de Méd. Opér.* p. 292.) But where a great deal of skin is saved all round the limb, and the muscles of the calf are not chiefly calculated upon for covering the bones, the perpendicular line of the wound will answer very well.

Many surgeons, however, operate differently. They first make the circular incision through the skin, two inches below where they mean to saw the bones. They next detach the skin from the muscles and bones equally all round the limb, to the extent of about a couple of inches. The integuments are then turned up, and a division of the muscles made all round down to the bones, on a level with the line where the detachment of the skin has terminated. The parts between the bones are afterwards cut through, &c. The hemorrhage having been stopped, the integuments are drawn down over the stump, and the line of the wound made either transverse or perpendicular.

The practice is sometimes adopted of sawing off the sharp upper ridge of the tibia. It is advocated by A. C. Hutchison, Marjolin, and Ballard. It has the sanction of Mr. Guthrie, who says, that, in thin persons, where the spine of the tibia is very sharp, this part should be removed with the saw. (P. 222.) In France, the removal of the front angle of the tibia is generally approved. (*J. F. Malgaigne, Op.* cit. p. 291.)

Occasionally, surgeons have also removed the small remnant of the fibula, and such was sometimes the practice of Larrey, when he amputated nearer the knee than common. (*Mém. de Chir.*

Mil. t. iii. p. 389.) This plan, however, is objectionable, as will be hereafter explained.

By some surgeons of repute, the above plan of amputating the leg so high up, when the foot or ankle is the part diseased or injured, has been condemned. It was strongly disapproved of by Solingen, towards the close of the sixteenth century. His precept was, that the leg, like the forearm, ought to be amputated as low as possible, and the patient furnished with a suitable mechanical contrivance, on which he would be able to walk exceedingly well. Dionis was nearly in the same way of thinking upon this subject as Solingen. The opinions of these surgeons, however, had fallen into such oblivion by the middle of the seventeenth century, that Ravaton, White, and Bromfield severally imagined, that they were the first inventors of amputations low down the leg.

Mr. White, of Manchester, in a paper dated 1769 (*Med. Obs. and Inq.* vol. iv.), informs us, that he took the hint to amputate a little above the ankle, from seeing a case in which this had been done by a simple incision, with such success that the patient could walk extremely well, though with a machine that was very badly constructed. After this, Mr. White began to operate above the ankle with the double incision; and he invented a machine, much better calculated for the patient to walk upon.

In 1773, Mr. Bromfield published his *Chirurgical Cases and Obs.*, wherein he mentions his having begun, about the year 1740, to amputate above the ankle, in a case of a gangrene of the foot. The patient walked so well, with the aid of a simple machine, both along a level surface, and in going up and down stairs, that it was difficult to perceive he had lost his foot. Mr. Bromfield was persuaded, however, to give up this practice, until he learned that, in 1754, a Mr. Wright had thrice amputated in this way with success, when he again had recourse to it, without the least unpleasant consequences. (See vol. i. p. 189, &c.) Of late, the method has been revived by Vacca, Brünninghausen, and Soulera, and is even sanctioned by Velpeau, under particular circumstances, as where the patient is not obliged to walk a great deal, or is very desirous of not letting it be seen that he has lost any part of the limb. (See *Velpeau, Nouv. Elém.* t. i. p. 480). Velpeau recommends cutting the skin in such a manner that the cicatrix may be situated behind and not in the centre of the stump. But, as Malgaigne observes, the delicate skin in this place would hardly be capable of bearing the pressure of the kind of short boot on which the patient would have to walk. (See *Malgaigne, Manuel de Méd. Opér.* p. 294.) He prefers, therefore, amputating at the place of election, except when the operation is practicable at the ankle-joint.

The advantage of amputating a little below the knee, is, that the pressure in walking with a wooden leg is entirely confined to the front of the limb, the cicatrix itself not being subjected to irritation. After amputating at the ankle, the pressure in walking operates directly on the cicatrix. According to Sabatier, this last plan has been extensively tried in France, but not found to answer, the stump being incapable of bearing pressure, and not continuing healed. (*Médecine Opératoire,* t. iii. p. 377. edit. 2.) The same author refers to some instances, in which the patients were obliged, under these circumstances, to undergo amputation a second time; an observation made as long ago as the time of Paré. Baron Larrey speaks of the method as an objectionable operation, not merely because some patients, as, for instance, soldiers, have not the means of providing themselves with artificial legs of the above description, but because it is almost always followed by bad symptoms, owing to the small quantity of cellular substance and flesh, and the thickness of the bone at this part of the leg, whereby cicatrization is impeded. A nervous irritation is more apt to be produced by this than the common mode of operating, and the suppuration, which is always sanious, takes place with difficulty. "I have (says Larrey) seen many amputations done at this part; but nearly all the patients died of nervous fever, or tetanus." (*Mém. de Chir. Mil.* t. iii. p. 394.) Mr. Liston also pronounces the operation near the ankle to be inadmissible, because a sufficiency of soft parts for the protection of the stump cannot be obtained below the calf. The place for incision, he observes, is consequently limited to two points, — either immediately below the tuberosity of the tibia, or in the bellies of the gastrocnemii. The former situation he prefers in hospital practice, and among the lower orders generally; the latter in the better classes of society, who can afford to purchase an expensive artificial support. (*Elements, &c.* part iii. p. 391.)

In flap-amputations below the knee, Alanson and Lucas conjectured, that the cure might be rendered more safe, easy, and expeditious, by applying the flap, with the view of uniting it by the first intention.

The following case explains Mr. Alanson's flap-operation: — The disease was in the left leg; the patient, therefore, lay upon his right side, upon a table of convenient height, so as to turn the part to be first cut fully into view. The intended line, where the knife was to pass in forming the flap, had been previously marked out with ink. A longitudinal incision was made with a common scalpel, about the middle of the side of the leg; first on the outside, then on the inside, and across the tendo Achillis: hence, the intended flap was formed, first by incisions through the skin and adipose membrane, and then completed by pushing a catling through the muscular parts in the upper incised point, and afterwards carrying it out below, in the direction of the line already mentioned. The flap was thick, containing the whole substance of the tendo Achillis. The usual double incision was made; the retractor applied to defend the soft parts; and the bone divided, as high as possible, with the saw.

The flap was placed in contact with the naked stump, and retained there, at first, by three superficial stitches, between which adhesive plasters were used. Notwithstanding the patient caught an infectious fever a few days afterwards, the stump healed in three weeks, except half an inch at the inner angle, where the principal vent had been. In another week, the wound was reduced to a spongy substance, about the size of a split pea. This, being touched with caustic, healed in a few days. The man was soon able to use an artificial leg, with which he walked remarkably well. He went several voyages to sea, and did his business with great activity. He bore the pressure of the machine totally upon the end of the stump, and was not troubled with the least excoriation or soreness.

In the next instance, in which Mr. Alanson operated, he formed the flap by pushing a double-edged knife through the leg, and passing it downwards and then outwards, in a line, first marked out for the direction of the knife. In this way, the flap was more quickly made.

The leg should be completely extended during the operation; and kept in that posture till the wound is perfectly healed.

Notwithstanding Mr. Alanson's favourable report of the first of these amputations low down the leg, I fully coincide with my colleague, Mr. Liston, that the method should be abandoned; for I have known several persons, whose stumps, formed in this manner, were never capable of bearing pressure. For authorities in support of this statement, I may also refer to Paré, Sabatier, and Velpeau. (*Nouv. Elém. de Méd. Opér.* t. i. p. 479.)

I will next notice Mr. Hey's method. He was satisfied that very near the ankle was not the proper place for this kind of amputation.

Some cases occurring, in which, from a scrofulous habit, the stump would not heal completely, nor remain healed, Mr. Hey determined to try whether amputation, in a more muscular part, would not secure a complete healing, and give the patient an opportunity of resting his knee on the common wooden leg, or using a socket, as he might find it most convenient. Mr. Hey latterly preferred this method, which he reduced to certain measures.

It had been customary, at the Leeds Infirmary, to make the length of the flap equal to one third of the circumference of the leg. This was determined by the eye of the operator, who usually pushed the catling through the leg, near the posterior part of the fibula. Mr. Hey, finding the flap was not always of the proper breadth, began to determine this by measure, and then operated as follows: — To ascertain the place where the bones are to be sawn, together with the length and breadth of the flap, he draws upon the limb five lines, three circular, and two longitudinal ones. He first measures the length of the leg from the highest part of the tibia, to the middle of the inferior protuberance of the fibula. At the mid-point, between the knee and ankle, he makes the first or highest circular mark upon the leg. Here the bones are to be sawn. Here also Mr. Hey measures the circumference of the leg, and thence determines the length and breadth of the flap, each of which is to be equal to one third of the circumference. Mr. Hey takes a piece of marked tape, or riband, and places one end of it on the front edge of the tibia. Supposing the circumference to be twelve inches, he makes a dot in the circular mark on each side of the leg, four inches from the anterior edge of the tibia. These dots must, of course, be four inches apart behind. From each of these dots Mr. Hey draws a straight line downwards, four inches in length, and parallel to the front edge of the tibia. These lines show the direction which the catling is to take in making the flap. At the termination of these lines, Mr. Hey makes a second mark round the limb, to show the place where the flap is to end. Lastly, a third circular mark is to be made, an inch below the upper one, first made for the purpose of directing the circular cut through the integuments, in front of the limb. The catling, for making the flap, should be longer than those commonly employed in amputations. Mr. Hey uses one which is seven inches long in the blade, and blunt at the back, to avoid making any longitudinal wound of the arteries, which is very difficult to close with a ligature; and, for the same reason, he pushes the catling through the leg, a little below the place where such muscles are to be divided as are not included in the flap; the limb being nearly horizontal, and the fibula upward, he pushes the catling through the leg, where the dot was made, and carries it downward along the longitudinal mark, till it approaches the lowest circular mark, a little below which the instrument is brought out. The flap being held back, Mr. Hey divides the integuments on the front of the limb along the course of the second circular mark. The muscles not included in the flap are then divided a little below the place where the bones are to be sawn. No great quantity of these muscles can be saved, nor is it necessary, as the flap contains a sufficient portion of the gastrocnemius and soleus muscles to make a cushion for the ends of the bones. After sawing the bones, Mr. Hey advises a little of the end of the tendon of the gastrocnemius to be cut off, as it is apt to project beyond the skin, when the flap is put down; and he recommends the posterior tibial nerve, when found on the inner surface of the flap, to be dissected out, lest it should suffer compression.

As strips of adhesive plaster cause great pressure on the end of the stump, Mr. Hey prefers sutures for keeping the flap applied; small strips of court plaster being put between the ligatures.

Sir Charles Bell proposed another sort of flap-amputation. The operation is not to be done so low, as there will not be a sufficiency of muscle to cover the end of the bones. An oblique cut is to be made, with the large amputating knife, upward, through the skin of the back part of the leg. The assistant is to draw up the skin, and the knife is to be again applied to the upper margin of the wound, and carried obliquely upward till it reaches the bones. The knife, without being withdrawn, is next to be carried, in a circular direction, over the tibia and fascia, covering the tibialis anticus, until it meets the angle of the first incision on the outside of the limb. The surgeon is then to pierce the interosseous membrane, &c. The sawing being completed, and the arteries secured, the flap is laid down, and the integuments of the two sides of the wound will be found to meet. (*Operative Surgery*, vol. i.) Langenbeck disapproves of the plan of pushing the knife through the calf of the leg, as practised by Alanson, Hey, Graefe, Liston, Lisfranc, Syme, &c., because an inexperienced surgeon may run the point between the two bones, and in this way the wound is never made evenly. His manner of forming the flap is very similar to Sir C. Bell's, except that he first makes three cuts in the integuments, two longitudinal and one transverse, by which the shape of the flap of skin is determined. (*Bibl. für die Chir.* b. i. p. 571.)

Mr. Liston's mode of amputating with an anterior and a posterior flap below the knee, is the most simple and expeditious of all the plans with which I am acquainted, and, what is still of greater importance, forms an excellent stump. I will introduce the description of it, after noticing Larrey's proposal, that amputation may often be done with advantage much nearer to the knee than the usual place; a doctrine which is now generally acknowledged to be correct, and the truth of which is confirmed by the results of Mr. Liston's practice.

Flap-amputation of the leg, I mean that operation in which a flap both of skin and muscle is preserved, is often considered more painful than the common method. Yet, when we come to see what respectable names are recorded in its favour, how soon the stump frequently heals, how well the ends of the bones are covered, and how all dissection of the integuments from the fascia is avoided in this mode of operating, at least as far as the flap extends, the method must be allowed to possess weighty recommendations. Indeed, in its present improved state, and with the peculiar fitness of such a stump for adhesion, this operation, I think, is again rather rising in the estimation of the profession. In 1816, Klein had performed flap-amputation of the leg about twenty times. If the flap should happen to be made too large, he particularly dwells on the propriety of removing part of it at once; and, when it is too short, he enjoins carrying the incision a little further upwards without delay. He confesses that the plan is attended with some little trouble in securing the interosseous arteries, which are apt to retract considerably; but, such has been the success of his practice, that out of twenty cases seventeen got well, and most of them very soon, without the least exfoliation, and the other three died of typhus. (*Practische Ansichten der bedeutendsten Chir. Op.* 1ste Heft, p. 47.) In the same work, this experienced surgeon, convinced how much more quickly and certainly the wound heals after amputations with two flaps, than those with one, has suggested a plan of amputating below the knee, so as to form two lateral flaps. On the other hand, as already mentioned, it is only in amputating below the knee, that Dr. Bushe conceives the circular incision decidedly preferable to the flap-operation. He "never saw a case, where a flap was formed from the calf of the leg, in which considerable retraction of the remaining muscles did not ensue, attended with great induration of the flap, separation of its edge from the skin on the front of the tibia, sometimes exfoliation of the bone, and generally tedious suppuration." (*Lancet*, No. 246. p. 208.)

The principal reasons have already been specified for the general custom of amputating the leg about four inches below the patella; and if the disease or injury will not admit of the operation being done thus low, of removing the limb above the knee-joint. In the Egyptian campaign, however, Baron Larrey performed two amputations very near the knee-joint, almost on a level with the head of the fibula, which he judged proper to extirpate. The successful result of these operations dispelled the fear, which this experienced surgeon previously entertained, about amputating in the thick part of the upper head of the tibia; for no caries of this spongy portion of the bone, no bad effects on the knee-joint, and no anchylosis of the stump ensued; and, with the difference of a few days, the wound healed as readily as that made in the common place of election, viz. three or four finger-breadths below the tuberosity of the tibia. Since the above-mentioned campaign, Larrey has adopted this practice in many cases, where it was impossible to have operated at the usual place; and he assures us, the success fully equalled what attends operations done at the ordinary distance from the knee. In 1806, another French military surgeon, who had tried this method himself, published a dissertation, in which he commended operating, where circumstances required it, much higher than the point allowed by generally received rules. Larrey differs, however, from Garrigues, in forbidding amputation higher than the level of the tuberosity of the tibia, the thick portion of which may be sawn, but not above the insertion of the tendon of the patella. A transverse line, drawn from this point, usually passes below the articulation of the fibula, and over the lower portion of the uppermost part of the condyles of the tibia; but, as the relative positions of the heads of the two bones to each other differ somewhat in different individuals, Larrey makes the tuberosity of the tibia the point above which the bone should never be sawn. By cutting higher, the ligament of the patella is separated from its insertion; the bursa mucosa, situated underneath it, is wounded; and the ligaments at the sides of the joint are injured; whence arise retraction of the patella, effusion of the synovia, and such disease of the knee-joint as may render another amputation indispensable. By making the division on a level with the tuberosity of the tibia, the attachment of the ligament of the patella is preserved, as well as that of the flexor tendons of the leg, which are requisite for the motion of the stump. The bursa mucosa is left untouched; and the head of the bone is sawn low enough to avoid creating a risk of caries. But, says Larrey, if this mode of amputating below the knee be compared with amputation of the thigh, as recommended by authors for the cases in which the new method is proposed, the advantages of the latter are considerable. In the first place, life is less endangered, because a smaller portion of the body is removed. The operation is as easy in one situation as the other. The stumps heal with equal facility. Larrey has never seen the spongy part of the tibia become carious, nor perceptibly exfoliate. When the remaining portion of the fibula is very short, as usually happens, he recommends it to be taken away, as it is an useless body, inconvenient for the employment of a wooden leg. He directs as much skin as possible to be preserved, and a perpendicular incision, through that part of it which covers the tibia, in order to hinder the bone from making its way through it by ulceration.

With a stump thus formed, comprising the knee and one or two finger-breadths of the leg, the patient has a firm point of support, on which he can securely walk without a stick. The stump admits also of an artificial leg of the natural shape being worn, the knee being always bent, provided the length of the stump do not exceed the diameter of the calf of the artificial limb. (*Mém. de Chir. Mil.* t. iii. p. 386—394.) From a passage, quoted by Mr. Guthrie, it would seem that Mr. Bromfield (*Chir. Obs. and Cases*, vol. i. p. 185.) advised amputating as near to the knee as could be done, without risk of cutting the ligament of the patella, so that the stump might not extend beyond the wooden leg. On the whole, Mr. Guthrie's own observations are favourable to this practice; but he candidly acknowledges his belief, that "it would not succeed when indiscriminately done in the hospitals of large cities," though it may frequently be practised in the army with advantage, provided the surgeon saw through the tibia below its tuberosity. (*On Gunshot Wounds*, p. 223. and 227.) Upon looking over the details of the cases recorded by Larrey in confirmation of the above statement, I was struck with one important fact, which does not justify a part of his commendations; viz. most of the stumps were above four months in healing; and that which healed most quickly was not well before the sixty-eighth day. (See *Mém. de Chir. Mil.* t. iii. p. 57. 397, 398, &c.) Hence, unless it be supposed, that the wounds, produced by amputation below the knee in the ordinary manner, are generally thus long in healing, as treated by the French surgeons, the inference is rather unfavourable to the method so highly commended by Larrey.

One advantage of this operation is, that frequently only the popliteal artery requires a ligature, this vessel not dividing till lower down. Before adjusting the flaps, Mr. Liston sometimes cuts off the sharp anterior edge of the tibia with the pliers, for the purpose of preventing it from injuring the integuments. Mr. Liston objects to Larrey's method of cutting away the head of the fibula, because, in several cases where he tried it, a discharge of synovial fluid occurred on the second day, followed by profuse long-continued suppuration. In more than one case, the joint became anchylosed, and one patient died from the copiousness of the discharge. Mr. Liston found, from repeated examination of the parts in the dead subject, that, in cutting out the head of the fibula, the capsular ligament was wounded, or the bursal cavity beneath the popliteus muscle, communicating with that of the knee-joint. (*Elements*, part iii. p. 391—393.) If the tibia were affected very high up, the operation may sometimes yet be done.

When the patient cannot afford to purchase expensive artificial contrivances to walk upon, Mr. Liston always amputates immediately below the tuberosity of the tibia. If the right leg is to be removed, he places himself on its inner side, and grasps the lower part of the limb with his left hand, an assistant supporting the foot at a proper height. The knife is introduced over the outer side of the fibula, and carried upwards along that bone, for an inch and a half or two inches. It is then brought across the limb in a semicircular direction; and as soon as it reaches the inner and lower part of the tibia, transfixion is performed by pushing the knife across the posterior surface of the bone, and out at the upper part of the fibular incision. By then carrying the knife downwards, a posterior flap is formed sufficient to cover the bones. The integuments on the fore-part are then dissected upwards a little, with the same knife, so as to form a small semilunar flap. The muscles in the interosseous space are next cut through, and the knife carried round the bones in order to divide the soft parts. Yet for patients who can afford a more expensive artificial substitute for the lower part of the limb, and in whom a less efficient, though more handsome, contrivance is preferred, Mr. Liston amputates in the middle of the leg. The same directions apply to this operation as to that immediately below the knee, and the attachment of the ligament of the patella is left uninjured, by sawing the tibia obliquely upwards and backwards. (See *J. F. Malgaigne, Op.* cit. p. 295.) Indeed, as this author particularly remarks, the exact situation of the tuberosity of the tibia should always be precisely ascertained before the operation is begun, so as to avoid cutting through the insertion of the ligament of the patella, and opening the synovial membrane behind it. The tibial tuberosity presents a triangular surface, the inferior angle of which is continuous with the crista of the tibia. As the ligament of the patella is inserted into the whole of the triangular surface, J. F. Malgaigne sanctions, where circumstances call for it, a bold division of it nearly as high as its base, the remaining connection of the patella with the tibia by the latter part being sufficient. I fear this plan would too often be followed by injuries and disease of the knee-joint, to merit adoption.

Of the oblique or oval Amputation of the Leg.

The method adopted by M. Sedillot consists in dividing the integuments on the outer side of the leg obliquely, from before backwards, and from below upwards. The knife is then carried round the posterior part of the limb to its inner side from behind forwards, and from above downwards. The division of the integuments is next completed in front by a transverse incision, leaving an oval wound, with its anterior angle truncated.

The only difference in the process of M. Baudens from that of M. Sedillot, consists in making the incision through the skin entirely oval, and letting the knife descend about an inch lower down in front than behind.

"One reason," says M. Malgaigne, "not mentioned by any writer, makes me prefer the oval even to the circular method. In the latter, the principle is to leave the integuments sufficiently long on every side to cover one half of the stump. Now the posterior integuments, on the retraction of the muscles, reach the centre of the wound more readily than the integuments in front, which have to pass and bend over the end of the tibia. The object then can only be fulfilled by allowing a greater length to the skin in front." (*Manuel, de Méd. Opér*. p. 293.)

Oval amputation of the leg seems to me the most tedious and painful of all the modes hitherto proposed of removing this part of the limb. Nor can it be necessary, if care be taken in the other methods to save a sufficiency of the integuments in front of the limb, as advised in the descriptions already given of those operations.

Amputation of the Arm.

The structure of the arm is very analogous to that of the thigh: like the latter, it contains only one bone, round which the muscles are arranged. The deep muscles are attached to the os brachii, while the superficial extend along the limb, without being adherent to the bone. The first consist of the brachialis internus, and the two short heads of the triceps: the second of the biceps, and long head of the triceps. Hence, amputation may here be done in the same way as in the thigh, except when performed above the insertion of the deltoid muscle. In the arm, says Graefe, the incisions through the muscles should even be made more obliquely upwards than in the thigh, where the muscles are more bulky, by which means two inches of muscle may be saved, besides the retracted integuments; an abundance for covering the stump, were the arm full ten inches in circumference. (*Normen für die Abl. grösserer Gliedm.* p. 109.)

The patient being seated, the arm is to be raised from the side, and, if the disease will allow it, nearly into the horizontal position. As I have seen inconveniences produced by the patient's fainting in the midst of the operation, I join Graefe and some other practitioners in thinking that the patient, if already weak, should be placed upon a table in the recumbent position. (*Op.* cit. p. 108.) The surgeon is to stand on the outside of the limb, and apply the tourniquet as high as possible; or, if it be preferred, an assistant, standing behind the shoulder, makes pressure on the axillary artery with his four fingers. The skin and muscles, which are about to be divided, are to be drawn up and made tense. The soft parts are next to be divided, as much of the limb being preserved as possible. The retractor is to be applied, the bone sawn with the usual precautions, and the bleeding stopped in the ordinary way, care being taken to leave the median nerve out of the ligature, which is put round the brachial artery. The wound is then to be closed so as to form a tranverse line; the dressings are to be applied, and the patient put to bed, with the wound a little elevated from the surface of the bedding.

In amputation of the arm, I entirely coincide with Mr. Guthrie, with regard to the uselessness of dissecting back the integuments, a plan long ago renounced by Dupuytren, their effectual retraction by an assistant, after their complete division, being quite enough. (*On Gunshot Wounds*, p. 354.) In fact, the integuments are so loose and moveable over the fascia, that Alanson's painful plan of dissecting them from it is perfectly unnecessary. Instead also of attempting to perform the circular oblique incision through the muscles with one stroke of the knife down to the bone, it is a good plan first to divide the biceps only, and loose portion of the triceps immediately the integuments have been cut and retracted, and to let those muscles fully recede, before the division of the rest of the soft parts is begun. The incisions having next been carried down to the bone, the muscular fibres may be separated from it, if necessary, an inch or so further upwards, and the saw then applied as high as practicable.

Baron Dupuytren's method, which is a modification of that of M. Louis, is one of the most expeditious, and, I believe, in every respect commendable. The integuments are drawn up, and a circular incision made at once through them and the biceps, and loose part of the triceps. The edge of the knife is then applied close to the margin of the retracted muscular fibres, and the brachialis, the rest of the triceps, &c. divided by a circular incision down to the bone, directed sometimes perpendicularly, sometimes obliquely. Lastly, the muscular fibres, closely adherent to the part of the bone above the incision, are detached from it some way upwards with a scalpel, so that the saw can be applied higher up than would otherwise be practicable. This plan combines all the quickness of a flap-amputation with another advantage ascribed to the latter, namely, that of no risk of a subsequent protrusion of the bone.

If the disease should require the arm to be taken off at its upper part, there would be no room for the application of the tourniquet. Here, instead of putting a compress in the axilla, and having it held firmly upon the artery by a bystander, as advised by Sabatier, it is more eligible to make pressure on the artery as it passes over the first rib; of which method I shall speak in treating of amputation at the shoulder-joint. With a straight bistoury, the surgeon is now to make a transverse incision down to the bone, a little above the lower extremity of the deltoid muscle. Two other longitudinal incisions, made along the front and back edge of this muscle, now form a flap, which must be detached, and reflected. Lastly, the rest of the soft parts of the limb are to be divided by a circular cut, made on a level with the base of the flap, and the operation finished like a common amputation. (*Sabatier, Méd. Opér.* t. iii. p. 375, &c. ed. 2.)

As a matter of choice, and not of necessity, the arm may be amputated with two semilunar flaps: one, anterior; the other, posterior. The first should be formed of the skin, biceps, and brachialis, and be about three inches in length; the other is to be of the same size, and composed of the triceps and integuments. The muscular fibres, close to the bone, are now to be divided all round, and the saw used. Klein preferred this to the common method, and adopted it in nine cases. So well is the end of the bone covered, that a protrusion of it seems to him impossible. (*Practische Ansichten der Chir. Oper.* p. 44.) Langenbeck, instead of making the flaps in the preceding way, forms two lateral ones by cutting from below obliquely upwards, and turns the skin down to the bone. In one case in the North London Hospital, I lately tried this method; with one difference, namely, that of transfixing the soft parts, and cutting downwards and outwards, instead of cutting from without inwards, as practised by Langenbeck. This, as well as the preceding mode, is very quickly accomplished, and makes a good stump. Both also have the recommendation of being done without any painful dissection of the skin from the fascia, and of the bone being well covered not only by integument but muscle. Three strokes of the knife, as M. Velpeau observes, one for each flap, and another on the division of the muscular fibres adherent to the bone, and then the use of the saw, bring the operation to a conclusion. Yet it is contended, that flap-amputations of the arm are followed by more inflammation of the stump than circular ones, for which the round shape of the limb, and the moderate size of its single bone, seem admirably to adapt it. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 425.)

When the arm is injured very high up, Baron Larrey prefers amputation at the shoulder-joint to preserving a short stump, containing the upper end of the humerus; for, says he, if this bone cannot be divided at least on a level with the tendinous insertion of the deltoid, the stump is retracted towards the armpit by the pectoralis major and latissimus dorsi; the ligatures on the vessels irritate the brachial plexus of nerves; great pain, and nervous twitchings, often ending in tetanus, are produced; the stump continues swelled; and, in the end, the humerus is fixed by anchylosis to the shoulder, so that this portion of the arm remains altogether useless, and renders the patient liable to accidents. "I have seen (says Larrey) many officers and soldiers, who, on these accounts, were sorry that they had not undergone amputation at the shoulder." (*Mém. de Chir. Mil.* t. iii. p.53. 400.)

Mr. Guthrie also states, that when amputation by the circular incision is attempted at the insertion of the pectoralis major, the bone will generally protrude after a few dressings. However, he entirely dissents from Larrey, respecting the necessity of taking off the limb at the shoulder, and prefers doing it from half an inch to an inch and a half below the tuberosities of the humerus, as the state of the injury may require. Two incisions are to commence, one or two finger-breadths below the acromion; and the inner one is to be extended directly across the under side of the limb, till it meets the lower point of the outer wound. Thus the under part of the arm is cut by a circular incision; the upper in the same manner as it sometimes is in removing the limb at the shoulder-joint. Without detaching the skin from the muscles, these are cut through; the soft parts are held out of the way of the saw; the bone is sawn; the vessels secured; and the flaps brought together, so as to form a line from the acromion downwards. (*Gunshot Wounds*, p. 337, &c.) I am decidedly of opinion, that, in the description of cases referred to, either this method, or Sabatier's operation, should be preferred to the removal of the whole limb at the shoulder-joint.

Amputation at the Elbow-joint.

Dupuytren, convinced of the correctness of the principle that as much as possible of the upper extremity should always be saved, revived the practise of amputating at the elbow, whenever the state of this joint and of the soft parts admitted of such operation. The forearm being slightly bent, a double-edged knife is introduced transversely in front of the joint from one condyle to the other, and a flap made of the soft parts of the upper and anterior part of the forearm. The flap is now reflected, the capsular and lateral ligaments cut, and the operation finished by the surgeon sawing through the olecranon from before backwards. The brachial artery is not divided, but the radial and ulnar. The bleeding vessels having been secured, the flap is brought over the end of the humerus, and secured in this position with long straps of adhesive plaster.

When there is not a sufficiency of soft parts left for an interior flap, Dupuytren used to amputate at the elbow with the circular method, the first incision through the skin and fascia being begun three finger-breadths below the condyles. The integuments and fascia were then drawn upwards, the knife applied just below their edge, and the muscles divided down to the bone. By next carrying the knife a little upwards, and separating the soft parts from the bones, the joint was reached, and opened by cutting the lateral ligaments and forepart of the capsule. The operation was completed by dividing the olecranon with the saw. (See *Dupuytren, Leçons Orales de Clinique Chir.* t. iv. p. 316.) Amputation at the elbow was practised by Dupuytren in ten or twelve examples with great success, and the method is highly commended by Mr. Liston. (See *Elem. of Surgery*, part iii. p. 381.)

Amputation of the Forearm.

The wisest maxim, with respect to the place for making the incision, is to cut off as little of the limb as possible. This fact is perfectly established, notwithstanding the truth that Larrey, in consequence of his mode of dressing the stump, has not experienced success in his amputations done in the tendinous part of the forearm. The forearm is to be held by two assistants, one of whom is to take hold of the elbow, the other of the wrist. The tourniquet is to be applied to the lower part of the arm, and pressure made by an assistant on the brachial. The integuments should be drawn up so as to make them tense. The circular incision is then to be made down to the fascia; from this as much skin is to be detached, reflected, and saved, as is necessary for covering the ends of the bones, and the muscles are to be cut on a level with the reflected skin, the knife being at the same time directed obliquely upward. As many of the muscles are deeply situated between the two bones of the forearm, too much attention cannot be paid to dividing all of them, with a double-edged knife, introduced between the radius and ulna.

The soft parts are to be protected from the saw by a linen retractor. It is generally recommended to saw the two bones together, for which purpose the forearm should be placed in the utmost state of pronation. As the radius at the lower part of the forearm is larger than the ulna, it should perhaps be sawn through first, the latter bone, in consequence of its connection with the humerus, being better adapted to bear the weight of the saw. (*Averill's Op. Surgery*, p. 124.)

The ulnar, radial, and two interosseous arteries, are those which usually require ligatures.

Graefe removes the forearm by making a flap from the flesh in front of the limb, and then extending the wound quite round the member. (*Normen für die Abölsung grösserer Gliedm.* p. 138, &c. 4to. Berlin, 1812.) Mr. Guthrie makes two flaps, one in front, the other on the back of the forearm: but, above the middle of this part of the limb, he prefers the circular incision. (*On Gunshot Wounds*, p. 373, 374.) Dr. Hennen also expresses his approbation of amputating the forearm, so as to make two semilunar flaps (*Principles of Military Surgery*, p. 265. edit. 2.), which is the method recommended and practised by Klein (*Practische Ansichten bedeutendsten Operationen*, heft i. p. 45.); and Lisfranc also operates in this way at the lower third of the forearm. These flap-operations of the forearm are rather proceedings of choice than of necessity; for, I have seen this part of the limb removed in numberless instances by the circular incision, and can hardly remember a case in which the stump turned out badly. In making the inner flap, the radial and ulnar arteries must obviously be in danger of being wounded higher up than the point where they are quite cut through, as Mr. Guthrie candidly acknowledges; an accident, which might give rise to a great deal of trouble.

With respect to Larrey's preference to amputating in the fleshy part of the forearm, though the case would admit of the operation being done much lower, I need only say he would find no reason for this choice, were he to aim at union by the first intention, at every opportunity, as is the custom in England.

Amputation at the Wrist or Radio-carpal Articulation.

The hand may be amputated at the joint of the wrist, whenever the disease does not extend too high, and a flap can be made either from the integuments of the back of the hand, or from those of the palm. Lisfranc makes both an anterior and a posterior flap. The circumstances of the case should determine the choice. Here amputation may also be done by the circular incision. The scaphoid, semilunar, and cuneiform bones form a convexity, which is almost entirely received in the concavity of the radius, the ulna having no connection with this joint, except through the intervention of the triangular ligament, and to the extent of about four lines. The styloid processes of the radius and ulna can be readily felt, and below them the articulation commences; but, as Malgaigne observes, the direction of the joint is less easily determined; and if, while the hand is extended, the wrist itself be alternately bent and extended, these motions will take place in the medio-carpal articulation, into which the surgeon might erroneously carry the knife. The following are the instructions given by M. Malgaigne, for the avoidance of this mistake: —

1. If the hand be extended very much backward, the apex of the angle formed with the forearm will denote the radio-carpal articulation.

2. The transverse projection of the radius forwards may also be felt, the joint being one line below it, and about five lines above the cutaneous wrinkle between the palm and the forearm.

3. The situations of the ends of the styloid processes being determined, and a line drawn across from one to the other, the middle of the joint will be two lines and a half above such transverse lines.

4. If only the styloid process of the radius is perceptible, that of the ulna is known not to descend so far as it by two lines; and the middle of the joint is three or four lines higher. (*J. F. Malgaigne, Manuel de Méd. Opér*. p. 324.)

The projection of the pisiform and cuneiform bones beyond the level of the palmar surfaces of the radius and ulna, must be remembered in the operation.

Amputation by the circular method is performed as follows: — An assistant draws up the integuments, and the surgeon makes an incision through them all round the wrist, about an inch below the styloid processes. The skin may now be easily retracted nearly as high as the joint; a second incision, made so as to leave the pisiform and cuneiform bones just beyond it, divides all the tendons on a level with the retracted skin. The joint is then to be cut into on one side or the other, under the guidance of the corresponding styloid process, and the knife directed through the articulation in a line, answering to the posterior convexity of the scaphoid, lunar, and cuneiform bones. The radial and ulnar arteries are now to be tied, but the interosseous here seldom requires a ligature. The wound is to be closed with the line of it in the transverse direction, and the stump placed in a depending position, so that, if suppuration take place in the tendinous thecæ, or under the fascia, the matter may not pass far up the limb.

In the *double-flap-amputation*, as executed by Lisfranc, the hand and forearm are placed in the supine position, and supported by an assistant, who, at the same time, makes pressure on the radial and ulnar arteries. The surgeon, with a narrow knife, transfixes the soft parts on a level with the styloid processes, and from the radius towards the ulna or from the ulna towards the radius, according as he is operating on the right or on the left limb. The knife is then carried along the anterior surface of the carpus, and its edge inclined forward, so as to make a semilunar flap about two inches in length. This flap being held back, another very similar one is made on the back of the wrist; the extensor tendons are then to be cut through nearly on a level with the articulation, the joint opened just below one of the styloid processes, and the disarticulation finished, as in the circular method.

When the soft parts are so diseased that two flaps cannot be saved, the operation may be done with a single one, which should then be made somewhat longer.

Amputation at the Hip-joint.

The very idea of this formidable operation, for a long while, checked the hand even of the most ready advocate for the use of the amputating knife, and every mind shuddered at so extensive a mutilation. Still, it could not be denied, that the chance of saving life occasionally depended upon a submission to the greatest temporary suffering, and that, without the most cruel of sacrifices, the preservation of the patient was totally impossible. Dreadful as amputation at the hip appeared, both in respect to the magnitude of the part of the body to be removed, and the extent of the wound caused by such removal, the desperate nature of some cases at length began to incline surgeons to view more dispassionately a scheme, at which the mind at first naturally revolted. Morand is the earliest practitioner who made this severe operation the subject of attention. (*Opuscules de Chir*. t. i. p. 176. 8vo. 1768.) In 1739, two essays on the same topic were communicated to the Royal Academy of Surgery at Paris, by two of his pupils, Volner and Puthod. In 1743, Ravaton wished to have performed amputation at the hip-joint for a gunshot fracture of the trochanter major and neck of the thigh-bone, but was prevented by the opposition of other surgeons. (*Chir. d'Arm*. p. 323, &c.) In 1748, the propriety of attempting the operation was urged by l'Alouette. (*Disp. Chir. Halleri*, t. v. p. 265.) At length, the Royal Academy of Surgery at Paris thought the subject highly deserving of further investigation. In 1756, they therefore proposed the following question, as the grand prize subject: *In the case, in which amputation of the hip-joint should appear to be the only resource for saving the patient's life, to determine whether this operation ought to be practised, and what would be the best way of performing it?* No satisfactory memoirs having been presented, the same subject was proposed again in 1759. The approbation of the Academy was now conferred on a paper written by Barbet, in which the propriety of amputating at the hip-joint was defended, and some of the cases demanding the operation specified. If, for instance, a cannon-ball, or any other violently contusing cause, had carried off or crushed the thigh, so as to leave only a few parts to be cut to make the separation complete, he thought a surgeon ought not to hesitate about doing it. The same author conceived that a sphacelus extending to the circumference of the joint, and destroying the greatest part of the surrounding flesh, might also render the operation equally necessary and easy. (See *Sabatier, Méd. Opér*. t. iii. p. 271, &c.) Cases were also adduced, where the surgeon completed the separation of the dead parts with a knife. However, this cannot be considered as amputation at the hip-joint. Dividing a few dead fibres was a thing of no importance, in regard to the likelihood of its creating any bad symptoms. The proceeding, in fact, seems to me to have no analogy at all to the bloody operation of taking the thigh-bone out of the socket. It is quite a different thing, when the operator has to cut through parts which bleed profusely, and are endowed with life and sensibility.

In addition to the memoir by Barbet, thirty-three other essays were offered to the Academy, the majority of which were filled with arguments in favour of the operation; and, besides these productions, two other memoirs were published at Paris, one by Goursaud in 1758, explaining a new method of operating, and another by Moublet (see *Journ. de Médec.* an. 1759), in which, says Professor Thomson, the operation is ably considered in all its different relations. (*Obs. made in the Mil. Hospitals in Belgium*, p. 260—63.)

Some of the best surgeons of the last and present century condemn the proceeding. The following are Mr. Pott's sentiments: —"M. Bilguer and M. Tissot are the only people whom I have met with, or heard of, in the profession, who speak of an amputation in the joint of the hip as an advisable thing, or as being preferable to the same operation in the thigh." After a quotation or two, he continues — "That amputation in the joint of the hip is not an impracticable operation (although it be a dreadful one), I very well know. I cannot say that I have ever done it, *but I have seen it done*, and am now very sure I shall never do it, unless it be on a dead body. The parallel, which is drawn between this operation and that in the shoulder, will not hold. In the latter, it sometimes happens, that the caries is confined to the head of the os humeri, and that the scapula is perfectly sound and unaffected. In the case of a carious hip-joint this never is the fact; the acetabulum ischii, and parts about, are always, more or less, in the same state, or at least in a distempered one, and so indeed most frequently are the parts within the pelvis," &c. (*Pott on Amputation.*) Here it may be remarked, that Pott was right, inasmuch as the operation is totally unjustifiable in disease of the hip-joint; but wrong in not perceiving that, though unfit for such a case, it might be proper for others. Callisen had difficulty in supposing any circumstances, in which the operation could be undertaken with hopes of success. (*Syst. Chir. Hod.* p. 418. t. ii. edit. 1800.) And Richerand thinks, that, unless the limb be nearly separated by the disease, or accident, a prudent surgeon should decline making the attempt. (*Nosogr. Chir.* t. iv. p. 519. edit. 4.)

It is a remarkable fact in the history of surgery, that an operation, which had been invented in France, and concerning which so much had been written in that country, should have been first put in practice in England. "I have been informed," (says Professor Thomson,) "that the operation was performed in London by the late Mr. H. Thomson, surgeon to the London Hospital, and imagine that it must have been his operation to which Mr. Pott alludes." (*Obs. in the Mil. Hospitals in Belgium*, p. 264.) At all events, whether this was the identical case which Mr. Pott saw, or not, the example referred to by this distinguished surgeon is the earliest instance of the operation being actually performed. It was even repeated in this country before it was ever practised on the Continent, as far as can be made out from the records of the profession; for, it was performed by Mr. Kerr, of Northampton, on a girl between eleven and twelve years of age, in a case of diseased hip; a case, however, in which I am completely satisfied that it ought never to be attempted, for the reason laid down by Mr. Pott. In fact, Mr. Kerr, after removing the limb, found the acetabulum, and all the adjacent parts of the ossa innominata, carious. But the experiment was here rendered still more hopeless, by the patient being consumptive. Yet, with all these disadvantages, the girl lived till the eighteenth day from the operation, and, after death, her lungs were found to be a complete mass of disease, one of them being totally reduced to matter. (See *Duncan's Med. Commentaries*, vol. vi. p. 337. 8vo. Lond. 1779.) In the first successful amputation of the hip, M. Perrault, of Sainte Maure, was the operator. It was done in the year 1774, in a case of traumatic gangrene. The particulars are recorded by Sabatier. The patient, named Goix, recovered, and afterwards lived a good while as cook at an inn at St. Maure, where M. Velpeau saw his son in 1815. About the same time that Perrault's operation took place, another successful amputation at the hip seems to have been done by M. Perret, a French military surgeon. (See *Velpeau, Nouv. Elém. &c.* t. i. p. 514.) Although amputation at the hip used commonly to be demonstrated on the dead subject, by lectures on surgery in London, the observation of M. Velpeau is very correct, that in England and Germany little serious idea was entertained of reviving the practice of it on the living till the commencement of the present century, and that about this epoch several trials of it were made by surgeons of the French army. M. A. Blandin relates three cases. His first patient was operated upon (*Fructidor, an.* 3.) and recovered. The second also got well, and the third lived till the fifty-eighth day after the operation. About the same period, M. Perret, another military surgeon, had one successful case. In 1798, Mulder amputated at the hip with success, on a young woman aged 18. (See *Velpeau, Elém. de Méd. Opér.* t. i. p. 514.) Larrey performed this operation twice in Egypt; and once, while he was serving with the French army on the Rhine. He was encouraged to make these attempts to save his patients by the consideration, that he had already preserved some lives by amputating either both thighs, both legs, or both arms, or removing the humerus at the shoulder-joint. Larrey has also the merit of having first done the operation in the description of cases, in which (with the exception of bad examples of necrosis, or of incurable disease, of the higher part of the femur) it is more decidedly proper than any other; viz. gunshot injuries of the head, neck, and upper part of the femur, with or without injury of the femoral artery, or where the limb has been carried away by a shell, or cannon-ball, too high up to admit of amputation in the ordinary manner. However, he also regards as fit occasions for amputation at the hip-joint, circumstances in which, from gunshot violence, the limb is seized, or threatened with gangrene, nearly up to the hip. (*Mém. de Chir. Mil.* t. ii. p. 185.)

Severe as the operation is, Larrey contends that, if it ever prove the means of saving lives which are in danger, it is an act of humanity, and he argues that it is justifiable by the old maxim of Hippocrates, "Ad extremos morbos extrema remedia." To the chief objections which have been made to it, he replies, 1st, That the wound is more alarming than dangerous. The Cæsarean operation (says he) has been successfully performed on the living female, and is still recommended by many practitioners. L'Aumonier, principal surgeon of the Rouen Hospital, successfully removed a scirrhous ovary of considerable size. Examples are recorded of the arm and scapula being torn away, and the patients soon recovering. Besides, the surgeon has it in his power to lessen the wound produced by the operation. 2dly, The dangers of hemorrhage may be obviated by the assistants temporarily placing their fingers on the mouths of the cut vessels, until ligatures can be applied.

In confirmation of his sentiments, concerning the propriety of the operation, Larrey adverts to a fact reported by Morand, where a soldier had both his legs amputated very high up, and also both his arms so near the shoulders, that he could hold nothing in his armpits. Yet, mutilated as he was, he enjoyed good health. (*Opuscules de Chir.* p. 183.) And Larrey, in his own work, has recorded several instances, in which the whole of a limb was removed, or more than the halves of both the upper or lower extremities of the same subject, without any fatal constitutional disturbance. (*Mém. de Chir. Mil.* t. ii. p. 182—184.) One of his patients above alluded to survived the operation a week, at the end of which he was carried off by the plague; and the others died, after being conveyed, in a very uneasy manner, during a precipitate march of the army. (See *Relation de l'Expédition de l'Armée d'Orient en Egypte, &c.* p. 319. 8vo. Paris, 1803.) At the battle of Wagram, Larrey operated at the hip-joint on two soldiers of the imperial guard, under very unfavourable circumstances; these patients died in a few hours. (*Mém. de Chir. Mil.* t. iii. p. 349.)

Whatever method of amputating at the hip be adopted, the surgeon should remember, that the acetabulum is not deep enough to receive the entire head of the femur, which constitutes more than the half of a sphere, and is so embraced by the fibrous capsule, that it remains as it were strangulated, if this latter part be not divided close to the margin of the acetabulum. As for the ligamentum teres, it is rendered tense by abduction of the limb, and presents itself to the edge of the knife. On the contrary, if the operator begin with dividing the external portion of the capsule, the limb should be placed in the position of adduction; the ligamentum teres is then relaxed, but it makes no resistance to the disarticulation, and may afterwards be easily divided. The hip-joint is more superficial in front than in any other direction. A line drawn perpendicularly downwards, from the union of the middle with the external third of Poupart's ligament, will be sure to pass over the forepart of it.

Larrey operated as follows: — He began with making an incision in the track of the inguinal artery in the bend of the groin, and tied this vessel as closely as possible to Poupart's ligament, in order that the ligature, which was placed above the origin of the circumflex arteries and the profunda, might obviate all inconvenience from the bleeding, which might otherwise have happened from their numerous branches. This being done, a straight knife was perpendicularly plunged between the tendons of the muscles attached to the trochanter minor and the base of the neck of the femur, so as to bring out its point at the back part of the limb, or in a diametrically opposite situation to its first entrance; and now, by directing the knife obliquely inwards and downwards, a flap, which was not to be too large, was made of the soft parts at the inner and upper portion of the limb. This flap was now drawn towards the scrotum by an assistant, and the articulation was brought into view. The obturator artery, and some branches of the pudendal, wounded in making the flap, were immediately tied. The thigh was now put into the state of abduction; the inner part of the orbicular ligament, made tense by this position, was divided, and the joint opened. The ligamentum teres was then cut, and the bone dislocated. The knife was next brought to the outside of the great trochanter, and an external flap formed of the soft parts, calculated to meet that which had been made at the inner side of the limb. In proceeding through the operation, Larrey secured, as soon as they were divided, the obturator arteries, and several branches of the pudendal, gluteal, and ischiatic arteries. The two flaps were brought together, and kept in this position, with strips of adhesive plaster, and a woollen spica bandage. (See *Mém. de Chir. Mil.* t. ii. p. 186—188.)

In the Russian campaign, Larrey had two more opportunities of amputating at the hip-joint. In the first instance, he operated upon a Russian at Witepsk, whose thigh-bone was broken to pieces up to the trochanter, and the soft parts of two-thirds of the thickness of the limb destroyed. This man went on as favourably as possible until the 25th day from the operation, the parts being healed except at two points, where the ligatures had been brought out; but, unfortunately a scarcity of provisions now occurred, and the patient died on the 29th or 30th day. The second operation was done on a French dragoon, after the battle of Mozaïsk, who was afterwards seen perfectly cured by the surgeon-major, at Orcha, who received him there, and made a report of the fact to Larrey. (See *Mém. de Chir. Mil.* t. iv. p. 26. 50, 51, 8vo. Paris, 1817.)

In 1812, M. Baffos amputated at the hip nearly in the manner of Larrey, except that he only compressed the artery in the groin, and did not begin with tying it, a method to which Larrey himself now gives the preference. (See *Mém. de Chir. Mil.* t. iv. p. 434.) The patient was only seven years old, and the case a diseased hip. The wound healed, but the child died of scrofula three months afterwards. The cotyloid cavity was found full of fungous flesh, and the os innominatum carious. As the latter state always exists in the diseased hip-joint, the whole of the disease does not admit of removal by amputation, and consequently the attempt ought never to be made. (See JOINTS, DISEASES OF.)

The plan of operation, adopted by Baffos, is considered, I believe, by all surgeons of the present day, better than that formerly practised by Larrey, inasmuch as the unnecessary preliminary measure of taking up the artery in the groin, instead of simply compressing it against the os pubis, was rejected. Cutting down to the artery as a precaution against hemorrhage, is doing a double operation, and putting the patient to needless suffering: it was the earliest method, having been proposed by Volther and Puthod. Who was the first proposer to compress the artery against the os pubis, instead of cutting down to the vessel, I am not at present aware; but the plan was publicly recommended by Mr. Abernethy, in his anatomical lectures, for the last thirty years of his life.

Lisfranc is said to complete amputation at the hip-joint upon the dead subject in ten seconds; the following is his method, as described by a modern writer: — The nates of the patient resting on the edge of the table, and the limb being supported by an assistant, the operator draws a line an inch in length, from the anterior and superior spinous process of the ilium, straight down the thigh. From this point, he marks another inwards towards the pubes, of half an inch, so as to form a right angle. On the inner extremity of the last, he places the point of a long-bladed catling, and pushes it perpendicularly downwards, till it strikes against the head of the femur. Then passing it on the outer side of the bone, he thrusts it onwards till it protrudes at about an inch from the margin of the anus. He now cuts outwards, for near an inch, in order to clear the great trochanter, and forms the external flap, four or five inches in length, by cutting down the limb between the muscles and bone. The femoral artery, which may now be seen, is compressed between the fingers and thumb of an assistant, while the operator thrusts the knife in and out at the same points, as before; but, carrying it on the inner side of the head of the bone, he forms a smaller flap on that side of the extremity. Then, with the point of the knife, he cuts through the capsular ligament, dislocates the bone, and removes the limb by dividing the round ligament, &c. (See *Averill's Operative Surgery*, Lond. 1823, p. 158, &c.; *Maingault, Méd. Opératoire*, fol. Paris, 1822.) It is obvious (says Mr. Syme) that so long as the surgeon merely cuts downwards, and keeps close by the bone, he will not injure the femoral artery, which cannot be divided till the knife is carried outwards. This is one great excellence referred by Lisfranc to his operation; for, before the surgeon cuts the artery, the assistant can introduce his fingers into the wound, and compress the vessel.

The disarticulation is accomplished as follows: The surgeon, seizing the limb with his left hand, while the assistant holds aside the flaps, makes a cut half round the margin of the acetabulum at its fore part. The limb is then put into the posture of abduction, the bone starts from its socket, the knife is carried round its head, and the triangular ligament, and remains of the capsular ligament, are divided. (See *Ed. Med. Surg. Jour.* No. 78. p. 41.) A similar method of operating was followed by Walther. (See *Graefe and Walther's Journ.* Also *Anderson's Quarterly Journ.* vol. i. p. 630.) It was likewise preferred by Mr. Syme, in an interesting case, where he amputated at the hip-joint for an extensive necrosis of the femur, involving the neck of the bone. Unfortunately, when the wound was nearly healed, the patient became dropsical, and died at the beginning of the eighth week from the period when his limb was taken off. (*Op.* cit. p. 25.) Dupuytren made a semilunar incision, with its convexity downwards; it began near the anterior superior spine of the ilium, and terminated near the tuberosity of the ischium. Only the skin was first divided, which was then retracted by an assistant, and the muscles cut in the same direction, so as to form the internal flap four or five inches long. This was reflected, the capsule opened in Larrey's manner, the knife passed through the joint, and the outer flap made. Dupuytren and Béclard preferred compressing the artery on the horizontal branch of the os pubis to applying a ligature to it. Here we find two very high authorities in support of what has always seemed to me the best practice.

Langenbeck begins the first incision on the outside of the femoral artery, and forms the external flap, by extending the wound towards the tuberosity of the ischium. The knee is then inclined inwards, and the head of the femur dislocated: after which the knife is carried to the inside of the thigh, and the inner flap made. (*Bibl. für die Chir.* b. iv. s. 512.) Béclard's method seems to differ from this, chiefly by transfixion being adopted in making the flaps. The same observation applies to Lisfranc's plan. It would be useless to describe every variety of operating where the only peculiarity consists either in making the outer or the inner flap first; or in transfixion, and then cutting from within towards the skin; or in not transfixing the limb, but cutting from the integuments inwards. Some operators also make one flap longer than the other; while others, with Delpech, consider the wound more likely to heal favourably when only an internal flap is made. (See *Velpeau, Nouv. Elém.* t. i. p. 522.)

When serving with the army in Holland in 1814, I assisted the late Dr. Cole in the performance of this operation. The plan adopted by him was that taught by Mr. Abernethy, in his lectures, for more than thirty years. The flow of blood through the femoral artery was stopped by compressing the vessel in the groin with the handle of a key covered with lint. The thigh was then amputated as high as possible, close below the trochanters. The femoral artery was immediately secured, and afterwards every other vessel requiring ligature. An incision was now made near the border of the acetabulum, the cotyloid ligament divided, and the head of the bone removed with the utmost facility and expedition. The patient lost even less blood than in an ordinary amputation, and the wound admitted of being brought together with adhesive plaster in the best manner possible, so as to represent a transverse line. I am sorry to add, that the patient lived only till the following day. In one dreadful case of fracture of the upper part of the femur by a grape-shot, where the operation had been delayed too long, the whole limb being inundated with matter, and the upper end of the lower portion of the bone projecting through the flesh backward, I ventured to perform the same operation at Oudenbosch in Holland, a few days after the assault on Bergen-op-Zoom; and here happened what must often occur: immediately the soft parts had been divided, as the bone was broken to pieces, the limb came off, leaving the head of the bone, the trochanters, and a small piece below them projecting. Had not the man appeared in a very bad way by the time the vessels had been secured, I should now have removed the head of the bone; but the shock of the operation was such that he survived it but a few minutes, though scarcely any blood was lost. The mode of operating by the circular incision is preferred by Graefe, who unknowingly considers it as a new method. (*Normen für die Abl. grösserer Gliedm.* p. 118.) It has also been proposed by Dr. Veitch, with the modification of leaving an inch or two of the bone projecting, which is done without giving any additional pain, by dissecting off the soft parts below the first incisions down to the bone. This projecting piece is intended to serve as a lever, with which the head of the bone is to be got out of the acetabulum. (*Edin. Med. and Surg. Journ.* vol. iii. p. 129.) Ingenious as this suggestion may be, I do not regard it as an important practical improvement; 1st, because in almost all cases where the operation is necessary, the bone is so fractured that its division is already made by the injury: 2dly, because the scheme is unnecessary; for, in Dr. Cole's case, where I assisted, the head of the femur was removed from the acetabulum with the utmost facility by merely making an incision over that cavity, cutting the ligaments, and availing ourselves of the small piece of bone accidentally projecting. In fact, in all gunshot injuries requiring this operation, excepting a few instances of spreading gangrene from wounds, the bone is usually broken too high for Dr. Veitch's method to be practicable. With the same view of facilitating the exit of the head of the bone from the acetabulum, Graefe (p.123.) recommends dividing the transverse ligament which completes the brim of the anterior and inferior sides of the socket. Disarticulation will always be free from difficulty, however, if the capsule be divided close to the borders of the acetabulum.

Sir Astley Cooper commenced his operation by making an incision just below Poupart's ligament, a little on the outside of the femoral artery. The wound was then carried obliquely downwards and outwards to the back of the thigh, about one third of the way down it, from which point the knife was carried in the opposite direction, obliquely upwards and inwards to meet the first incision, so as to form an elliptical curve. The femoral artery, being now divided, was immediately tied. The muscles were next cut through, another artery secured, and the bone taken out of its socket. Only about twelve ounces of blood were lost.

The following method, recommended by M. Scoutteten, is stated not yet to have been practised on the living subject (*Velpeau, Nouv. Elém.* t. i. p. 525.), though Sir Astley Cooper's plan seems to have been very similar to it in regard to the track of the incisions. The patient is to lie on the opposite side of the body to that on which the operation is to be done. The inguinal artery is to be compressed. The surgeon, standing behind the limb, is to put the thumb or forefinger of his left hand on the great trochanter. With the right he introduces the point of the knife perpendicularly over this process, and then gradually depressing the handle, extends the incision forwards and inwards four finger-breadths below the groin. He then carries the knife round the limb, cutting as deeply as possible, and bringing the knife at length up to the point from which the wound commenced. All the muscular fibres are rarely divided by this first incision, and hence the knife must generally be applied again, ere this first stage of the operation can be completed. For the purpose of getting at the capsule, the sides of the wound must be kept apart, and any muscular fibres, not yet cut, be divided. As soon as the capsule is perceived, it is to be cut through perpendicularly on the head of the femur. The limb is now to be somewhat depressed, and the foot turned outwards, whereby the head of the bone is forced nearly out of its socket, and quits it completely as soon as the round ligament is cut, which is the only part by which it is confined. The operator then raises the thigh bone, so as to make its head project; after which he cuts the rest of the capsule and muscular fibres, and completes the separation of the limb. When the operation is on the left side, the surgeon stands in front of the limb. (See *Scoutteten, Méthode Ovalaire, ou Nouvelle Méthode pour amputer dans les Articulations,* Paris, 1827, 4to.)

Mr. Liston prefers anterior and posterior flaps. The patient is placed on a firm table, with the nates projecting a little beyond its edge. The sound limb may be secured to the foot of the table with a towel; all occasion for an assistant to hold it being thus done away with, and more freedom afforded to the operator in his movements. The other limb is supported by one assistant, while another presses with one or both thumbs on the femoral artery, where it passes over the pubes. Transfixion is then performed horizontally, the knife passing in a somewhat semicircular direction, so as to include as much of the soft parts as possible, and an anterior flap is made by cutting downwards. During the passage of the knife across the joint, the assistant, holding the limb, rotates the limb, if it be the right one, a little outwards, or, if it be the left, in the contrary direction, so as to facilitate the bringing of the point of the knife through the skin well inwards. After the formation of the flap, the assistant abducts the limb forcibly, and depresses it; the joint is opened; the round ligament cut; the rest of the capsule divided; the blade of the knife placed behind the great trochanter; and the posterior flap quickly formed. After transfixion for the anterior flap, and when the sawing motion of the knife has made a little advance, the compressing assistant shifts his hands into the incision immediately behind the back of the knife, and thus obtains a firm grasp of the femoral artery, previously to its division. He retains this hold during the rest of the operation, at the same time retracting the flap. As soon as the limb is off, the bleeding vessels in the posterior flap are compressed, and tied as quickly as possible. Lastly, the femoral artery is secured, which, while the assistant retains his hold of it, will not bleed. (See *Liston's Elements*, part iii. p. 395.) The methods of M. Plantade, M. Manec, and Mr. Ashmead (see *Velpeau, Nouv. Elém.* &c., t. i. p. 520.) are all only modifications of the foregoing plan. M. Plantade makes the principal flap in front, and seems to have been one of the greatest advocates of this method, which he began to recommend in 1806.

Amputation at the hip-joint has now been performed in many instances, and the patients saved. The earliest example of success is that done, as I have stated, by M. Perrault in 1774. Other successful operations, done by Blandin and Mulder, I have already noticed. Another successful amputation of the hip, (the first by any British surgeon,) was performed by Mr. Brownrigg, staff surgeon, on the 12th of December, 1812. The upper part of the thigh-bone had been broken by a gunshot near Merida, in Spain, on the 29th of December, 1811. Some time ago, the man was living at Spalding in Lincolnshire in perfect health. Other successful amputations of the hip are those performed by Larrey at Witepsk; by Mr. Guthrie in the Netherlands on a French prisoner of war; and by Sir Astley Cooper, who performed the operation on account of a disease of the higher part of the femur. As the patient had formerly suffered amputation of the thigh, it was certainly not the sudden removal of nearly a quarter of him; but, I cannot presume to say, what difference in the chances of success, and whether any, would be connected with the circumstance. The same remark applies to a case lately under Mr. Mayo, where the patient, a young woman, recovered. The proceeding was adopted on account of the agony experienced by the patient from a neuralgic affection of her stump.

In June, 1824, amputation at the hip was done by Delpech, on account of a necrosis of the femur, and the patient was completely well in the following September. (See *Revue Médicale.*) The operation was also performed by Dr. Mott, of New York, on the 7th of October, 1824, and the whole of the wound had healed by the 20th of November. This case was a bad fracture of the upper part of the femur, followed by abscesses and disease of the bone. (See *Philadelphia Journal*, No. 9. vol. v. New Series.) The patient's age was favourable, as he was a boy of only ten years of age. At this period of life, the chances of success will always be greater than in adults, not only in consequence of the remedial power of nature being then particularly great, but on account of the smaller dimensions of the wound necessary for the purposes of the operation. Another successful amputation at the hip was performed by Mr. Orton, in 1826; the disease commenced in the knee; but terminated in extensive disease of the thigh-bone, large abscesses, and dislocation of the knee, the leg being fixed in the bent position, and drawn under the thigh. (See *Med. Chir. Trans.* vol. xiii. p. 605.) The operation has also been performed with a successful result by Wedemeyer and Bryce.

On the other hand, the failures of this operation are numerous, though undertaken by surgeons of reputation and ability. Mr. Guthrie, Dr. Emery, Mr. Brownrigg, Baron Larrey, Baron Graefe, Sir B. Brodie, Mr. Carmichael (*Trans. of the Assoc. Physicians*, vol. iii.); Drs. Blick, Emery, and Cole; Baron Dupuytren; MM. Gensoul, Clot, Roux, Delpech, Pelletan, Dieffenbach, Syme, Velpeau, and Walther, have each had the mortification of losing at least one of their patients, after this very severe operation.

A calculation has been made, that the proportion of recoveries has been six in twenty operations. At all events, it appears, that, in the course of ten years, nearly twenty well-authenticated instances of recovery, after this severe operation, have occurred. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 515. *Chelius, Handb. der Chir.* b. ii. p. 763.)

No one can expect, however, this operation not to fail in a large proportion of the cases in which it is attempted: this must always happen, let it be done in the most skilful manner possible. Yet, as there are unquestionably some descriptions of injury, where life must inevitably be lost if this proceeding be rejected, and experience proves that it sometimes answers, an important consideration is, what cases are most proper for it? Here I am decidedly of opinion, with Professor Thomson, that the examples in which it is particularly called for, and where no delay should be suffered, are those in which the head or neck of the thigh-bone has been fractured by a musket-ball, grape-shot, or small piece of shell. Eight or ten such cases, where amputation ought to have been done in the first instance, were brought in waggons several days after the assault on Bergen-op-Zoom into the hospital superintended by myself at Oudenbosch, and not one of these patients lived ten days after their removal. In the whole course of my professional life, I have never elsewhere witnessed so much suffering, or suppuration in such profusion. From each limb, at least three or four pints of matter were discharged daily. Had amputation at the hip been performed at first, some of these patients might possibly have been saved; at all events, I am certain that it was their only chance.

Larrey deems the operation proper, where the thigh has been shot off high up, or where the femur and soft parts near the hip have been broken, and extensively lacerated by a cannon-ball or pieces of shell. Here the operation (though perhaps the only chance) must almost always fail, because, as Professor Thomson observes, these injuries occasion a shock to the constitution, of which the patient mostly sinks either immediately, or in a few hours. (*Obs. made in the Mil. Hosp. in Belgium*, p. 274.) The truth of this observation I saw exemplified at Merxham, near Antwerp, at the bombardment of the French fleet in that port; a shell burst between the thighs of one of the guards; tore and lacerated two-thirds of the thickness of the upper part of the right thigh; broke the ascending ramus of the ischium; lacerated the perineum and scrotum; and fractured the higher part of the femur. There was no hemorrhage of consequence; but the exposed lacerated surface of the soft parts was immense, and the unfortunate soldier, who lay with his hairs standing erect, and bereft of his intellectual faculties, sunk in the course of a quarter of an hour into a state of insensibility, and was quite dead in twenty minutes. However, there are numerous cases, in which the patients, after dreadful injuries of the upper part of the thigh, are less depressed and overcome, and live several weeks; facts clearly proving, that the operation ought to be attempted. Many instances of this kind are related by Mr. Guthrie. (*On Gunshot Wounds*, p. 134, &c.) Bad and incurable disease of the upper part of the femur (not the scrofulous hip, nor any other example in which the pelvis is affected) may also require the performance of amputation at the hip joint, as was recently illustrated in the practice of Mr. Syme, and in that of Sir Astley Cooper. The case in which Mr. Carmichael amputated at the hip was what is termed an osteo-sarcoma: the patient, a girl, nineteen years of age, died on the fifth day. (See *Trans. of the King's and Queen's College of Physicians, Ireland*, vol. ii. p. 357, &c.; and vol. iii. p. 158.) Dr. Mott's case was one of fracture of the upper part of the femur, ending in disease of the bone and extensive abscesses. The disease for which Delpech operated was necrosis of the thigh-bone. The propriety of the operation in desperate cases is now perfectly established.

Thus, as M. Velpeau observes, a comminuted fracture, an osteo-sarcoma, a spina-ventosa, any incurable disease of the femur extending above its shaft; gangrene; in short, any disease reaching to the vicinity of the hip, and so serious as to require the removal of the limb, are cases for amputation at this joint, provided the acetabulum and the bones of the pelvis be unaffected. It is indispensable for gunshot wounds of the upper third of the thigh, combined with fracture. (See *Nouv. Elém. de Méd. Opér.* t. i. p. 516.) It was performed by Mr. Mayo for a neuralgic affection of a thigh stump.

Amputation at the Shoulder-joint.

The head of the humerus represents nearly the half of a sphere, scarcely one-third of which is received by the glenoid cavity of the scapula, the rest being contained in the exceedingly loose capsule of this articulation. The articular surfaces are held together principally by the deltoid, supra-spinatus and infra-spinatus, teres minor, and subscapularis muscles. The joint is also very much strengthened by the tendon of the long head of the biceps, and by the accessory ligament extending from the acromion to the upper part of the humerus. Above the articulation is a kind of osseo-fibrous arch, formed by the acromion, the coracoid process, and the ligament stretched between them. This arch projects more than an inch in front of the glenoid cavity, and descends further in the direction backwards than in that forwards. (See *J. F. Malgaigne, Manuel de Méd. Opér.*, p. 328.) If we examine the anatomy of the shoulder, from above downwards, we first meet with the deltoid muscle, covered by the integuments, some fibres of the platysma, and a very thin fascia. Then we come to a loose cellular tissue, the tendons of the supra-spinatus, infra-spinatus, subscapularis, and teres minor, the accessory ligament and fibrous capsule, and the tendon of the long head of the biceps. Lower down we arrive at the scapular portion of the triceps; and then the brachial plexus of nerves, the axillary vessels; and, under the skin, the pectoralis major, the latissimus dorsi, and the teres major. The apex of the acromion is very perceptible just above the cushion of the shoulder, as well as the coracoid process more towards the chest. Between these bony points is situated a triangular interval, useful to be recollected by the practical surgeon, bounded outwards and downwards by the head of the humerus; above by the clavicle and acromion, or rather by the coraco-acromial ligament; and inwardly by the coracoid process itself. This is the place where the joint may be at once cut into, without any impediment from the bones; and it is on the knowledge of this fact, that Lisfranc proposed one of his methods of amputating at the shoulder. When the posterior border of the axilla is reflected towards the scapula, as Velpeau observes, the knife may be made to pass below the acromion, into the superior and external part of the joint. In some persons the acromion is much more prominent than in others; and occasionally it is considerably depressed, so that its humeral aspect forms a deep concavity. In childhood, it is cartilaginous; and Velpeau found it in two adult bodies separable by a very slight effort, as an epiphysis from the spine of the scapula. (*Velpeau, Nouv. Elém.* t. i. p. 428.) The course of the circumflex arteries, that of the circumflex nerve; the situation of the accessory ligament extended from the acromion to the humerus; and, in particular, the origin and track of the tendon of the long head of the biceps, between the fibrous capsule and the synovial membrane into the bicipital groove of the humerus; the mode in which the capsule is attached to the humerus just below its anatomical neck; the very open angle formed by the junction of the head with the shaft of the bone; and the circular shape of its head, requiring an incision of corresponding figure for the prompt division of the fibrous capsule, — are all interesting points of surgical anatomy, without a due knowledge of which a surgeon cannot amputate at the shoulder with skill and judgment.

The principal methods of amputating at the shoulder are comprised under four varieties: 1st, the operation with one flap; 2d, with two flaps; 3d, by the oval method (*Scoutteten*); 4th, by a circular incision (*Alanson, Sanson,* &c.) Here one fact merits particular attention, namely, that no mode of amputating at the shoulder can be exclusively employed in all the cases requiring the operation, because the soft parts around the joint are frequently destroyed, or very much injured, to a greater or lesser extent, so that the surgeon is obliged to save skin and muscles wherever he can find them. On this point, Dupuytren fully agrees with the surgeons of the British army.

Whether the operation done by Laroque, in 1686, was truly an amputation at the shoulder joint, or merely the separation of a gangrenous limb by a natural process, and a little assistance of the surgeon, may admit of dispute. I believe that H. F. Le Dran performed the first operation of this kind, of which the particulars are clearly recorded. It was in a case of caries and exostosis, reaching from the middle to the neck of the humerus. Le Dran began with rendering himself master of the bleeding, for which purpose he introduced a straight needle, and a strong ligature under the artery. This was passed from the front to the back part of the arm, as closely to the axilla and bone as possible. The ligature, then, including the vessels, the flesh surrounding them, and the skin covering them, was tightened over a compress. Le Dran, with a straight narrow knife, then made a transverse incision through the skin and deltoid muscle down to the joint, and through the ligament surrounding the head of the humerus. An assistant now raised the arm, and dislocated the head of the bone from the cavity of the scapula. This allowed the knife to be passed with ease between the bone and the flesh. Le Dran then carried the knife downward, keeping its edge always somewhat inclined towards the bone. In this manner he gradually cut through all the parts, as far as a little below the ligature. As there was a large flap, Le Dran made a second ligature with a curved needle, which ligature included a great deal of flesh, the redundant portion of which was cut off together with the first ligature, which had become useless. The cure was completed in about ten weeks. (*Obs. de Chir.* t. i. p. 315. Paris, 1731; and *Traité des Opér.* p. 365.) Le Dran (the son), who published this memorable case, does not state that the operation was a new one; and it appears from the *Recherches Critiques sur l'Origine, &c.*

de la Chirurgie en France, and from La Faye's notes on Dionis, that it had been previously practised by Morand, the father.

Garengeot thought that the ligature might be applied by means of a curved needle, with sharp edges; and, in order to lessen the wound, he directs the incision to begin two or three finger-breadths below the acromion, across the deltoid muscle, so as to form one flap; then a lower one was made in the axilla; and after the second ligature had been applied, the two flaps were brought into contact. (*Traité des Opér. de Chir.* t. iii. p. 350.; *Mém. de Acad. de Chir.* t. ii. p. 261.)

La Faye extended the improvements further. After placing the patient in a chair, and bringing the arm into a horizontal position, he made a transverse incision in the deltoid muscle down to the bone, four finger-breadths below the acromion. Two other incisions, one in front and the other behind, descended perpendicularly to this first, and made a large flap of the figure of a trapezium, which was detached, and turned up towards the top of the shoulder. The two heads of the biceps, the tendons of the supra-spinatus, infra-spinatus, teres minor and subscapularis, and the capsular ligament, were next divided. Now, when the assistant, who held the lower part of the limb, made the bone describe the motion of a lever, upward, the head of the bone was easily dislocated. La Faye next carried his incision downward, along the inner part of the arm, until he was able to feel the vessels, which he tied as near the axilla as possible. The separation of the limb was then completed, a finger's breadth below the ligature. The flap was then brought down over the glenoid cavity, and the wound dressed. (See *Nouvelle Méthode pour faire l'Opération de l'Amputation dans l'Articulation du Bras avec l'Omoplate, par M. La Faye, in Mém. de l'Acad. de Chirurgie*, t. v. p. 195. ed. in 12mo.) With respect to La Faye, it is curious to remark a coincidence between him and Larrey: the latter, though generally adverse to the attempt of uniting stumps by the first intention, is an advocate for this practice after hip-joint amputation; so La Faye, who was fearful of laying down the flap after amputation of the leg, had no such apprehension at the shoulder.

La Faye's method is yet regarded as one of the most approved, where the state of the soft parts will admit of it. But it is absurd to think of applying any one plan to all the various states in which the injured or diseased limb may present itself. It is advised by Larrey himself, when a wound extends through the upper part of the arm, breaking the bone, and injuring the soft parts. Here, says he, it would be impossible to form an anterior and a posterior flap, because the soft parts in these situations have been destroyed. On the contrary, when the deltoid is shot away, La Faye's plan is inadmissible. (*Mém. de Chir. Mil.* t. ii. p. 167.)

The advantages of La Faye's plan are obvious. As only one ligature was applied, the patient was saved a great deal of pain; the flap connected with the acromion was capable of covering the whole surface of the wound, and was more easily applied and kept on the stump than the lowermost of the two flaps which Garengeot recommended; and the discharge found a ready outlet downwards.

In 1774, Alanson amputated at the shoulder-joint, as follows: The subclavian artery was compressed by the fingers of an assistant. An incision was made about a hand's breadth below the acromion, and carried through the integuments all round the limb. The deltoid and posterior muscles were then obliquely divided up to the capsular ligament. The tendon of the biceps, and the capsular ligament upon the anterior and posterior part of the joint, were now cut through. One of the circumflex arteries, which bled a good deal, was next tied. The great pectoral muscle, the rest of the capsule, and all the other parts, except the vessels and nerves, were then divided; but previously to cutting the vessels, a temporary ligature was put round them. Thus the separation of the limb was completed. The mouths of the vessels were drawn out and tied, and the temporary ligature taken away. Lastly, the sides of the wound were brought together, so as to make a transverse line. Graefe, seeming not to recollect that amputation by the circular incision, directed obliquely upwards, had been practised by Alanson, and even by some surgeons spoken of by Garengeot, mentions it as a new proposition. In one case, after operating in this manner, his patient was quite well in three weeks; and, with the particular sort of knife which he uses, and which is broadest towards its point, he pretends to be able to make the oblique incision through the muscles all round the limb with one sweep. He is careful to make pressure on the artery, both with Mohrenheim's compressor applied under the clavicle, and the fingers of an assistant above it. (See *Normen für die Abl. grösserer Gliedm.* p. 110, &c.) In proof of the possibility of making the oblique incision quite evenly with one stroke of his particular knife, he injected a female subject, did the operation, and caused the stump to be drawn from nature. (See Plate 2. of his Work.) M. Cornuau and M. Velpeau have also suggested modifications of circular amputation at the shoulder. In the method of the former, the integuments, being drawn up by an assistant, are divided four inches below the acromion, and the muscles next cut through transversely by one stroke of the knife, from the coraco-brachialis to the tendon of the teres major. The muscles are then raised, the joint opened, the knife passed through it from above downwards, close to the neck of the humerus, and a second transverse incision made, which joins the extremities of the first, divides the artery, and leaves a circular wound. This would not be a disadvantageous method, were the soft parts all tolerably sound.

M. Velpeau informs us, that he has tried on the dead subject every variety of the circular method, and he believes that no other plan is more expeditious, or leaves a more regular wound, or one more disposed to union by the first intention. He prefers dissecting up, and reflecting the integuments for two inches, without meddling with the artery; and then cutting the muscles in M. Cornuau's way, as close as possible to the joint, through which the knife is to be carried; and finally, the triceps divided, together with the artery, which is first to be taken hold of by an assistant. (See *Velpeau, Nouv. Elém.* t. i. p. 430.)

In 1760, P. H. Dahl published at Gottingen a dissertation on amputation at the shoulder. In this tract a tourniquet was proposed, the pad of which was calculated to press upon the subclavian artery under the clavicle, and enabled the operator to dispense with tying the vessels in the first instance. Camper had observed, that if the scapula were pushed backward, and the axillary artery pressed with the finger between the clavicle, coracoid process, and great pectoral muscle, the pulse at the wrist might be instantly stopped.

Dahl's tourniquet was obviously constructed, in consequence of what Camper had observed. It is made of a curved elastic plate of steel, to the shortest end of which a pad is attached, capable of projecting further by means of a screw. The instrument embraces the shoulder from behind forward, while the pad presses on the hollow under the clavicle, between the margins of the deltoid and pectoral muscles. The long extremity of the steel plate, which descends behind the shoulder, is fixed to the body by a sort of belt. The pad is depressed until the pulsation of the axillary artery is stopped.

Further experience has proved, however, that this tourniquet may be dispensed with, and the flow of blood in the axillary artery commanded, by properly compressing this vessel with the end of a key covered with soft materials, or even with the fingers alone, as some operators prefer, at the place where the vessel emerges from between the scaleni muscles, above the middle part of the clavicle. Thus the artery is pressed between the pad or fingers and the first rib, across which it runs. In certain plans of operation hereafter to be described, all compression of the artery, either above or below the clavicle, is dispensed with.

Some practitioners, forgetful of the horizontal posture in which the patient is usually placed after the operation, have feared that, in La Faye's method, the lower flap may sometimes confine the discharge. In order to avoid this inconvenience, Desault recommended the formation of two flaps, one of which was anterior, the other posterior. The axillary artery was compressed from above the clavicle, at its coming out from between the scaleni muscles, whilst the integuments and flesh of the upper and internal part of the arm were pushed away from the humerus. A knife was plunged between these and the other soft parts behind, to make the anterior flap. The arm being inclined backward and outward, the humeral artery was tied, the articulation opened, and the head of the bone dislocated. The knife was then carried downward and backward, so as to form the posterior flap, the incisions meeting in the axilla. (See *Sabatier, Méd. Opér.* t. iii. p. 393—399, ed. 2.)

Larrey, who had frequent opportunities of amputating at the shoulder-joint, aimed at the same object which Desault did; but, in his earlier operations, he was in the habit of beginning with the formation of the external or posterior flap, for the following reason: by proceeding in this way, the surgeon can tie the humeral artery more safely, because the ligature is applied after the operation is entirely finished, and consequently at a time when there is nothing to be attended to but the hemorrhage. Thus, the patient being placed on a stool, and well supported, the arm is to be raised from the side, and the axillary artery compressed from above the clavicle. The integuments and other soft parts of the upper and outer portion of the arm are then to be pushed away from the humerus, and the external flap formed. It is now very easy to cut the tendons of the infra-spinatus and teres minor, and open the outside of the joint. The limb is to be carried inward, and luxated backward. The tendons of the supra-spinatus and biceps are to be divided; and as soon as the head of the bone is out of the glenoid cavity, the knife is to be carried along the internal part of the head and neck of the humerus, with its edge close to the bone. An internal flap, equal to the external one, is to be formed, consisting of a portion of the deltoid, great pectoral, biceps, and coracobrachialis muscles, and including the brachial vessels and nerves. The artery is to be taken hold of with a pair of forceps, and tied. Any other vessels, which require a ligature, are also now to be secured. Larrey puts charpie betwixt the flaps, and brings them towards each other by the usual means. (See *Mém. de Chir. Militaire*, t. ii. p. 170.) Of this method of putting charpie to prevent union by the first intention, I entertain the most unfavourable opinion.

When Larrey published his campaign in Egypt, he had operated in this way on nineteen patients, thirteen of whom recovered. But, at a subsequent period, he and his colleagues had amputated at the shoulder, in the above manner, in upwards of a hundred cases, more than ninety of which recovered. (*Mém. de Chir. Mil.* t. iv. p. 432. 8vo. Paris, 1817.)

In his latter operations, he adopted the innovation of first making a longitudinal incision from the acromion to about an inch below the neck of the humerus, down to the bone, so as to divide the fleshy part of the deltoid into two even parts. This cut, he says, facilitates and renders more exact the rest of the operation. From this wound, the incisions for the flaps are continued. Having made the foregoing incision, "I direct an assistant to draw up the skin of the arm towards the shoulder, and I form the anterior and posterior flaps by two oblique strokes of the knife made from within outwards and downwards, so as to cut through the tendons of the pectoralis major and latissimus dorsi. There is no risk of injuring the axillary vessels, as they are out of the reach of the point of the knife. The cellular connections of these two flaps are to be divided, and the flaps themselves raised by an assistant, who, at the same time, is to compress the two divided circumflex arteries. The whole joint is now exposed. By a third sweep of the knife, carried circularly over the head of the humerus, the capsule and tendons running near the articulation are cut; and the head of the bone being inclined a little outwards, the knife is to be carried along its posterior part, in order to finish the section of the tendinous and ligamentous attachments in that direction. The assistant now applies his forefingers over the brachial plexus, for the purpose of compressing the artery, and commanding the current of blood through it. Lastly, the edge of the knife is turned backwards, and the whole fasciculus of axillary vessels is cut through, on a level with the lower angles of the two flaps, and in front of the assistant's fingers. The patient does not lose a drop of blood; and ere the compression is remitted, the extremity of the axillary artery is readily seen, taken up with a pair of forceps, and tied. The circumflex arteries are next secured, which completes the operation." (*Mém. de Chir. Mil.* t. iv. p. 428. Paris, 1817.) In addition to these important deviations from his earlier method, he subsequently preferred bringing the flaps together with two or three straps of adhesive plaster, and interposed no charpie. P. 429.)

It should be observed, also, that he lays no stress on first making the outer flap, though, from the description, it does not exactly appear which flap he now begins with. He has changed, likewise, on another point of importance; viz. instead of preferring La Faye's plan, in certain examples already specified, he affirms, that the above described way of operating is applicable to almost every case met with in military practice. First, because all gunshot wounds, generally, which mutilate the arm, so as to create the necessity for the operation, partly or entirely destroy the centre of the deltoid, while there is always enough flesh left at the sides for making the two flaps. Secondly, because, in the very rare instances where the lateral parts of the shoulder are destroyed, and the middle untouched, no advantage would be gained by operating in La Faye's manner, as Larrey conceives that the detached flap would slough, or become, as he terms it, disorganized. He now prefers dividing the middle piece of flesh, and giving the flaps the same shape as if they were uninjured. He even asserts, that the operation, done without any flaps at all, answers better than any method, in which the surgeon preserves flaps not naturally intended for the part. Thus, when all the flesh of the shoulder has been shot away, he has seen surgeons cover the glenoid cavity with a flap saved from the soft parts of the axilla; but such flaps invariably sloughed, hemorrhages ensued, and the patients died. (P. 430, 431.) Some of these latter observations are, clearly enough, the result of great partiality to a particular method of operating; because who can doubt, when the lateral parts of the shoulder are injured, as they frequently are (and not very rarely, as Larrey asserts), by the passage of a musket-ball through the shoulder, from before backwards, that the right method is that of La Faye; or the same operation, with the slight difference of making the flap of a semicircular shape? It was for cases of this description that Mr. Collier and the author of this Dictionary operated after La Faye's plan, with perfect success, after the battle of Waterloo; and a poor fellow of the rifle brigade, who was brought in too late for operation, and died of sloughing, had his shoulder injured in the same way, the middle of the deltoid being untouched, and shot-holes existing behind, and in front of, the articulation. But, if it required any further arguments to prove that Larrey is wrong in wishing to extend his, or rather Desault's method, to all cases, I might criticise his assertions about the sloughing of the flap, when it is not cut into two portions, and its preservation by the singular expedient of making a division of it, and, of course, injuring it still more, than it may have been injured underneath by the bullet. The cases, however, which have fallen under my own personal observation, and numerous others on record, furnish an adequate proof, that, excellent as Larrey's method is for many cases, La Faye's answers very well in others. Thus, in an example where a Prussian hussar had had his arm amputated, and a projection of the bone took place, to the extent of three inches, with hospital gangrene commencing in the stump, Klein felt obliged to remove the limb at the shoulder. He operated in La Faye's manner; the separation was finished in one minute; and, on the eighteenth day, the stump was perfectly healed. (See *Practische Ansichte Chir. Oper.* h. i. p. 1—10. 4to. Stuttgart, 1816.) The same practitioner had five other secondary amputations of the same kind; but one patient was afterwards carried off by hemorrhage, and another by hospital gangrene. Klein, however, in common with the majority of army surgeons, considers the idea of applying any one plan of operating to different cases totally absurd. (P. 12.) After the storming of St. Sebastian's, nine shoulder-joint amputations were done with success; seven of them by raising the deltoid as a flap. (See *Guthrie on Gunshot Wounds*, p. 108.)

After the battle of Waterloo, I adopted La Faye's plan; but with this difference, that I did not cut the brachial artery till I had made the last stroke of the knife, which separated the limb, and consequently I did not tie that vessel till the time when I had nothing but the hemorrhage to occupy my attention. The circumflex arteries I tied as soon as the external flap was made. The modification of thrusting a knife under the deltoid, quite across the shoulder, and making the flap by cutting downwards, until the instrument comes out again through the skin, has the recommendation of quickness, and the sanction of many good operators (Klein, Lisfranc, Dupuytren, &c.). An excellent lithographic plate illustrative of this last method, is given by Maingault, pl. 4. fig. 17. (See *Méd. Opérat.* p. 24. fol. Paris, 1812.)

When the state of the integuments will permit the choice, Mr. Guthrie thinks their preservation best effected by Larrey's first method; but he particularly insists upon the advantage of raising the shattered arm, or stump, to nearly a right angle with the body, before the operation begins, and even before the assistant makes pressure on the subclavian artery, as some change in the mode of accomplishing the latter object might be rendered necessary by elevating the limb during the operation itself. Mr. Guthrie commences the first incision immediately below the acromion, and, with a gentle curve, extends it downwards and inwards, through the integuments only, a little below the anterior fold of the armpit. The second incision outwards is made after the same manner; but is carried rather further down, so as to expose the long head of the triceps at the under edge of the deltoid. The third incision, commencing at the same spot as the first, but following the margin of the retracted skin, divides the deltoid on that side down to the bone, and exposes the insertion of the pectoralis major, which must be cut through. This flap is now to be raised, so as to expose the head of the bone. The fourth incision outwards divides the deltoid muscle down to the bone, when the posterior flap is to be well turned back, so as to bring into view the teres minor and infra-spinatus passing from the scapula to the great tuberosity of the humerus. The outer and inner flap being now raised, the head of the bone may be rolled a little outwards, the teres minor and infra-spinatus cut, and an opening made into the joint. The capsular ligament, supra-spinatus, and long head of the biceps are then divided. The inner side of the capsule is now cut through, together with the subscapularis muscle, as it approaches its insertion into the lesser tuberosity of the humerus. The long head of the triceps is next divided; and, lastly, with one sweep of the knife, the rest of the soft parts are cut, together with the axillary artery, veins, and nerve. (*On*

Gunshot Wounds, p. 274—276.) Larrey, in his latest method, takes no measures in the first stage of the operation for commanding the flow of blood, as the assistant merely presses the axillary artery between his fingers just before it is divided.

Some of the modern French surgeons were earlier than Larrey in dispensing with the compression of the axillary artery, and following a method which renders it unnecessary. Richerand, for instance, describes nearly the same plan as that advised by La Faye; but, after making the deltoid flap, cutting the tendons, and dislocating the bone, he dissects down close to the inside of the humerus, so as to enable an intelligent assistant to put his thumb on the cut surface behind the artery, which, with the aid of the fingers, applied to the skin of the axilla, can then be grasped and compressed, so as to command the flow of blood through the vessel. The operator now, fearless of hemorrhage, completes the internal or inferior flap. (*Richerand, Nosographie Chir.* t. iv. p. 509—511. edit. 4.)

Baron Dupuytren had two methods. In one, the arm being raised and held at a right angle with the trunk, Dupuytren stood at the inside of the limb, with one hand grasped and elevated the mass of the deltoid muscle, and plunged under it a two-edged knife, from before backward, on a level with the end of the acromion. Cutting in this way close to the head of the humerus, he continued the incision downward between this bone and the deltoid, and, at length bringing out the knife, completed the external or superior flap. The rest of the operation did not essentially differ from Richerand's, except that Dupuytren took hold of the lower flap itself, before dividing it, and compressed the artery, until he had cut through it and tied it.

In Dupuytren's second method, which he preferred to the first, whenever the state of the soft parts admitted of it, he formed an anterior and a posterior flap. The arm being raised to a right angle with the trunk, the heel of the interosseous knife, or catling, is placed below and a little in front of the acromion. Thence, the operator cuts with a firm hand, and by one stroke, all the soft parts at the back of the shoulder down to the posterior border of the axilla. The flap being raised, exposes the back of the articulation. The elbow is now carried to the front of the chest, so as to make the head of the humerus prominent, and the tendons and capsule are divided upon it. The bone having been disarticulated, the knife is carried round its head from behind forwards, is conveyed from above downwards along the anterior surface of the humerus, so as to form the second flap, the detachment of which is completed as soon as an assistant has taken hold of its base, and compressed the artery included in it between his finger and thumb. Unless the surgeon were an ambidexter, he should stand in front of the patient in operating on the left shoulder, and commence with the anterior flap. Dupuytren regarded this last method as particularly advantageous. The two flaps extend in the direction of the longest diameter of the wound, and can be brought together with exactness and facility. The ligatures, twisted into a single cord, and brought out downwards, form a kind of conductor for the purulent matter outward. The cicatrix resulting from the operation is linear, and promptly formed, with less risk of axillary abscesses than after the other method. The operation is also finished in less time than Larrey's. (See *Leçons Orales de Clin. Chir.* t. iv. p. 326.) These observations are subject to the consideration, that, when the patient is put to bed after the removal of the arm at the shoulder, the most depending point of the wound may be in some degree regulated by the position in which he lies. If an anterior and posterior flap were formed, he should lie with his chest raised forwards; if a flap had been formed above, and the line of the wound were transverse, he should be placed with the shoulder less elevated.

Another plan of amputating at the shoulder has been proposed by Lisfranc. Supposing the left extremity is to be removed, the patient is placed on an elevated seat, one assistant pressing the artery against the first rib, whilst another draws the arm forwards; the operator, standing behind the patient with a long-bladed catling, pierces the integuments on the inner edge of the latissimus dorsi muscle, opposite the middle of the axilla, and pushes it obliquely upwards and forwards, till its point strikes against the under surface of the acromion; then, by raising the handle of the knife, its point is lowered, and protruded just in front of the clavicle at its junction with the acromion. By cutting downwards and outwards, he then forms a flap from the superior and posterior part of the arm, including the whole breadth of the deltoid muscle, and a part of the latissimus dorsi. This being held back by the assistant, the joint is cut through from behind forwards, and a corresponding flap is formed by cutting downwards and outwards, between the muscles and bone, on the inner side of the arm. When the operation is on the right side, the patient should be seated on a low chair, and the catling thrust from above downwards, from the part just in front of the point where the clavicle is connected with the acromion, the surgeon raising his hand as the instrument proceeds downwards and backwards, until its point has come out at the inner edge of the latissimus dorsi, when the flap is to be made, and the operation finished as above directed. (See *Averill's Operative Surgery*, p. 135. Also *Lisfranc de St. Martin, et Champesme, Nouveau Procédé Opératoire pour l'amputation du bras dans son articulation scapulo-humerale.* Paris, 1815.)

Speaking of this mode of operating, Richerand remarks, "En l'employant, on parvient à désarticuler l'humérus, et à séparer le bras, en aussi peu temps qu'on met un habile découpeur à détacher l'aile d'un perdrix." (P. 514.)

A plan, long ago suggested by Pojet, and revived by Dr. Dorsey, consisted in making a perpendicular incision from the acromion down to the insertion of the deltoid muscle; separating the sides of the wound, in order to divide the capsule and tendons; dislocating the head of the bone; passing the knife between it and the soft parts from above downwards, and cutting through the latter with one sweep of the instrument. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 435.)

M. Scoutteten's oval method is done on the left arm, as follows:—The surgeon first takes hold of the middle of the arm with his left hand, and raises it four or five inches from the side. With his right hand he then applies the point of the scalpel immediately below the acromion, and passes it into the flesh until it touches the head of the humerus. He then depresses the handle, and forms the first incision, which extends downwards four inches from the point of the acromion, and divides the posterior third of the deltoid, and the greater part of the fibres of the long portion of the triceps down to the bone. The second incision is next commenced with the point of the knife directed downwards upon the inner side of the limb, and in front of the biceps, on a level with the place where the first incision ended. The wound is then extended inwards and upwards to the acromion, where it terminates by joining the first. These two wounds form a triangle, which partly consists of relinquished integuments, and has its base downwards.

In order to find the joint with greater ease, the surgeon may now detach a little of the deltoid from the bone. An assistant can also keep the edges of the incision asunder, so that the operator may be enabled to see and divide the capsular ligament and the tendons of the supra-spinatus, infra-spinatus, and teres minor, which are inserted into the greater tubercle of the humerus, and the tendon of the subscapularis, which is inserted into the lesser tubercle. The operator, who constantly keeps hold of the arm, now communicates to it some rotatory movements, in order to bring the above tendons, one after another, under the knife, and divide them with the capsule. Immediately the capsule and tendons have been cut through, the head of the bone readily quits its socket. The surgeon luxates the bone by pushing it a little upwards, and, at the same moment, inclining the condyles towards the side. The next proceeding is to divide the flesh on the inner side of the limb as closely as possible down to the bone; but, when the knife approaches the artery, this vessel is to be taken hold of and compressed by an assistant, before the incision is completed. In this way, no hemorrhage need be apprehended.

When it is the right limb, the only difference is, that the first incision is made at the inner side of the arm, and extended up to the acromion. Scoutteten considers a single assistant sufficient, and compression of the subclavian artery unnecessary. (*H. Scoutteten, La Méthode Ovalaire, ou Nouvelle Méthode pour amputer dans les Articulations.* Paris, 1827, 4to.)

When the scapula is shattered, of course the loose fragments should be taken away; and, if the acromion be broken, and the remnant of it pointed and irregular, this sharp rough portion should be sawn off, as was practised long ago by M. Faure. (See *Mém. de l'Acad. de Chir.* t. vi. p. 114.) In one case, indeed, Larrey found it necessary to take away more than two thirds of the scapula, and the humeral end of the clavicle. (*Mém. de Chir. Mil.* t. iv. p. 432.) Sawing off part of the acromion, and coracoid process, as a general rule, seems to me quite unnecessary (see *Fraser on the Shoulder-joint Operation*, 8vo. Lond. 1813) and improper, not only as producing delay, but wounding other parts which should not be at all disturbed. (See *Guthrie on Gunshot Wounds*, p. 285, 286, &c.) The practice of scraping away the cartilage of the glenoid cavity, except when it is diseased, is not of greater value.

Amputation at the shoulder has been partly superseded by a preferable operation, even in cases in which it would formerly have been deemed indispensable; such as considerable gunshot fractures of the head of the humerus, a caries of the substance of this part, &c. Boucher, in 1753, proved that considerable wounds, extending into the shoulder-joint, might be successfully treated, by extracting the fragments and splinters of bone. (*Mém. de l'Acad. de Chir.* t. ii. p. 287 et 461.) Instances are also recorded, in which, when the head and neck of the humerus in children had been totally disunited from the body of that bone, a cure was accomplished by making such incisions as allowed the portions of bone, now become extraneous bodies, to be taken away. The earliest case of this kind on record is that in which M. Thomas, a surgeon at Pezenas in Languedoc, removed the separated head of the humerus in 1740, which, in a child four years of age, presented itself loose in an incision, which had been previously made for the extraction of some sequestra. The particulars may be read in Guthrie's valuable work. (*On Gunshot Wounds*, p. 215, &c.) Mr. White, of Manchester, proceeded further; for he made a deep incision at the upper part of the arm; dislocated the head of the humerus, which he knew was carious; and, pushing it through the wound, took it off with a saw. He began an incision at the orifice of a sinus situated just below the processus acromion, and extended the wound down to the middle of the humerus, by which all the subjacent bone was brought into view. He then took hold of the patient's elbow; and, easily forcing the upper end of the humerus out of its socket, he brought it so entirely out of the wound that he readily grasped it in his left hand, and held it there till he had sawn it off with a common amputation saw, having first applied a pasteboard card betwixt the bone and the skin. The patient did not lose more than two ounces of blood, only a small artery, which partly surrounded the joint, being wounded, which was easily secured.

In about five or six weeks, the part from which the bone had been taken had acquired a considerable degree of firmness, and the boy was able to lift a pretty heavy weight. At the end of two months, a large piece of the whole substance of the humerus was ready to separate from the sound bone, and with a pair of forceps it was easily removed. After this exfoliation, the wound healed very fast, and, in four months after the operation, the boy was discharged perfectly cured. On comparing this arm with the other, it was not quite an inch shorter; the boy had the perfect use of it, and could not only elevate his arm to any height, but perform the rotary motion as well as ever. The figure of the arm was not at all altered. Mr. White did not make use of any splints, machine, or bandage, during the cure, in order to confine the limb strictly in one certain situation; nor was the patient's arm ever dressed in bed, but while he was sitting in a chair, and, as soon as he could bear it, standing up. To this method Mr. White attributed the preservation of the motion of the joint.

"As this is the first operation of the kind that has been performed, or at least made public (says Mr. White), I thought the relation of it might possibly conduce to the improvement of the art. That ingenious surgeon, Mr. Gooch, has indeed related three instances of the heads of bones being sawn off in compound luxations. In one of these cases, the lower heads of the tibia and fibula were sawn off; in another, that of the radius; and in the third, that of the second bone of the thumb; but these were in many respects different from the present case. I believe it will seldom happen, that this operation will not be greatly preferable to amputation of the arm at the scapula, as this last is generally performed for a caries of the upper head of the os humeri, and as the preservation of a limb is always of the utmost consequence, and what every surgeon of the least humanity would at all times wish for, but particularly where, as in this case, the whole limb, and its actions, are preserved entire, the cure no ways protracted, and the danger of the operation most undoubtedly less. For, though amputation is often indispensably necessary, and frequently attended with little danger or inconvenience when only part of a limb is removed, yet, when the whole is lost, the danger is greatly increased, and the loss irreparable." Mr. White concludes with suggesting an analogous operation for removing the head of the femur, in lieu of amputation at the hip. Something of this kind is indeed reported to have been actually done on a girl with success (see *Joannis Mulder, Oratio de Meritis P. Camperi, &c.* p. 81.; *Cases in Surgery, by C. White*, p. 57.; or *Phil. Trans.* vol. lix. for 1769); and my friend, Mr. Anthony White of the Westminster Hospital, in the year 1818, removed the head of the femur with a successful result. The patient was a boy, whose femur had been dislocated from the effects of a diseased hip, and the bone lay on the dorsum of the ilium, with the limb fixed across the other. The little patient had several fistulous openings in the hip, and was extremely emaciated, so that the head of the femur seemed very superficial. Mr. White, reflecting that the original structure of the joint had here been already annihilated; that the boy would die if no attempt were made to get rid of the diseased part of the femur; and that, even if he lived, the limb fixed in this manner across the other would only be an incumbrance, determined to operate. Being assisted by Mr. Travers, he cut down upon and exposed the head and neck of the femur; and having sawn through the bone just below the trochanter minor, he raised the detached fragment with an elevator, and extracted it: directly the saw had divided the bone, the limb could be placed in any position. At the end of a year the boy had recovered; and so useful a new joint was formed, that, with the assistance of a high-heeled shoe, he could walk well, and execute all the common movements of the limb. He lived several years afterwards, and then died of phthisis. The new joint is preserved in the Museum of the Royal College of Surgeons in London. A similar operation has also been performed by Sir Benjamin Brodie, but I am not acquainted with the particulars, or the result. Long after the publication of White's case of incision of the head of the humerus, viz. in 1767, an example, in which Vigaroux adopted the same practice, in 1788, was communicated to the profession: the result, however, was unfortunate, the patient, a lad seventeen years of age, having died soon after the experiment. (See *Œuvres de Chir. Prat., par I. M. I. Vigaroux (fils)*, Montp. 1812.)

Mr. Bent, of Newcastle, inserted a similar case to Mr. White's in the 64th vol. of the Philosophical Transactions. White made only one incision from the vicinity of the acromion down to the middle of the arm. Bent, not being able to get at the head of the bone through the wound which he had made, from the clavicle to the attachment of the pectoral muscle, detached a portion of the deltoid, where it is connected with the clavicle, and another part where it is adherent to the humerus. A third successful case is also reported in the 69th vol. of the same work, p. 6. Afterwards, Bromfield published some directions for the guidance of the surgeon in such operations. (*Chir. Obs. and Cases.*)

I think the cases, recorded by White and Bent, are truly important, inasmuch as they are the earliest models of a practice, which will sometimes supersede all occasion for one of the most formidable and mutilating operations of surgery. To military and naval surgeons, these cases cannot fail to be highly interesting, as they must have frequent opportunities of availing themselves of the instruction which they afford. Larrey, who was surgeon-general to the French army in Egypt, employed the practice with the greatest success, in cases of gunshot wounds. He thereby saved limbs, which, according to ordinary precepts and opinions, would have been a just ground for amputating at the shoulder; and, when it is considered, not only that a most dangerous operation is avoided, but that an upper extremity is saved, for which no substitute can be applied, we must allow that the plan, first suggested and practised by Mr. White, cannot be too highly appreciated. When the arm was fractured near its upper extremity by a musket-ball, most surgeons formerly deemed it necessary to amputate the limb. Here, says Larrey, it would be useless to dilate the entrance and exit of the ball, because a sufficient opening could not be prudently made in this way for the extraction of the head of the bone. Yet this body is now an extraneous substance, having lost its connection with the shaft of the humerus, and its presence exciting irritation and inflammation of the joint, abscesses, necrosis, &c. Here Larrey seems to imply that the detached head of the bone cannot unite again; an assertion which, I have no doubt, is incorrect, as I have attended several cases in which the humerus was broken very high up, yet united without difficulty. The bad symptoms, which he so emphatically attributes to the detachment of the head from the body of the bone, are in reality the effects of the gunshot violence itself. If, therefore, the head of the bone were merely broken off, and it and the neighbouring part of the bone not splintered, nor the flesh not more extensively injured than would arise from the passage of a musket-ball, and the joint itself not involved, I should question the propriety of having recourse, at once, either to the extraction of the head of the bone, or amputation at the shoulder. When the bone is shattered, the case is often different, and Larrey's practice is then commendable. In confirmation of these sentiments, I may mention Mr. Guthrie's opinion, who, in reference to the extraction of the head of the bone, says he does not consider a perfect fracture of the humerus, an inch below its head (although there be evident separation), as demanding even this operation, as he has known such cases to do well when treated as other compound fractures, except that the motion of the joint was nearly lost. (*On Gunshot Wounds*, p. 329.) However, it is fair to mention, that Mr. Guthrie inclines to amputation at the shoulder when the body of the bone is splintered, or has long fissures in it, in which sentiment he is undoubtedly right. The other operation seems principally calculated for cases, in which the damage is restricted to the head and uppermost portion of the bone.

According to Mr. Guthrie, when the ball passes out with little injury to the bone, and the openings already made are not sufficient to admit of a moderate examination with the point of the finger, the wound should be enlarged. However, others might argue, that such dilatation should be made only when the bone is felt to be seriously broken, and the fragments will probably require immediate removal. But whatever course be adopted, the most rigorous antiphlogistic treatment will be proper; and, if abscesses form, early and depending openings should be made for the discharge.

Larrey says, "I have had the good fortune, on ten different occasions, to supersede the necessity for amputation at the shoulder, by the complete and immediate extraction of the head of the humerus, or its splinters, without delay. I perform the operation in the following manner: I make an incision in the centre of the deltoid muscle, and parallel to its fibres, carrying the incision as low down as possible. I get the edges of the wound drawn asunder, in order to lay bare the articulation, of which the capsule is generally opened by the first incision; and by means of a probe-pointed bistoury, I detach with the greatest ease from their insertions the tendons of the supra and infra-spinati, of the teres minor, of the subscapularis, and of the long head of the biceps; then I disengage the head of the humerus, and remove it through the wound in the deltoid by means of my fingers, or of an elevator. I bring the humerus up to the shoulder, and fix it in a proper position with the aid of a sling and a bandage. Such is the operation which I performed on ten patients, in extirpating the head of the humerus; one of these died of the hospital fever, two of the scurvy, at Alexandria; and the fourth, after he was cured, died of the plague on our return to Syria. The rest returned to France in good health. In some, the arm became anchylosed to the shoulder; and in others, an artificial joint, allowing of motion, was formed." (See *Mém. de Chir. Militaire*, t. ii. p. 175.) Another successful case, of the same kind, was published by Mr. Morel. (See *Medico-Chirurg. Trans.* vol. vii. p. 161.)

Mr. Guthrie thinks it not sufficient to make a simple incision through the deltoid muscle into the capsular ligament, and take away the fragments of bone, but urges the removal at the same time of a considerable part of the capsular ligament, lest disease still go on in the joint. Also, as it is impossible to know, beforehand, in what state the bone may be below the fracture (that is, with respect to fissures running more or less down it), he advises the incision, designed for the extraction of the splintered head of the bone, to be made in a situation where, if amputation at the joint be found indispensable, it will be of advantage. Mr. Guthrie likewise describes the manner of turning out the head of the bone in these cases, and sawing it off; the necessity of which, however, I do not clearly comprehend, unless the taking away of any sharp spicula of the upper end of the body of the bone be implied, which may be right. (*On Gunshot Wounds*, p. 333—335.) My ideas, however, chiefly extend to the removal of loose fragments, and splinters; and, with respect to sawing off the head of the bone, this is a proceeding, I suppose, necessarily limited to the kind of cases reported by Mr. White and Mr. Syme. (*Edin. Med. and Surgical Journ.* No. 88. p. 49.)

In Mr. Syme's example, the head of the humerus was diseased. A perpendicular cut was made from the acromion through the middle of the deltoid, extending nearly to its insertion. A similar incision was then made upwards and backwards from the lower end of the first wound, and a large flap formed from the back portion of the deltoid, "which, being held up, exposed the joint so far, that (says Mr. Syme) I was able to insulate the head of the bone by means of my finger, and then to detach the scapular muscles from their connections with the tuberosities, when, the arm being brought forwards, I easily protruded the head of the humerus, embraced it in my left hand, and sawed it off without any injury to the other parts." (*Op.* cit. p. 51.) A portion of the acromion being diseased, was removed with the cutting pliers. From what has been stated, it may be inferred that, when the object is merely to extract splinters, a single perpendicular incision will suffice; but that when the joint is diseased, and the head of the bone requires to be sawn off, the operation will be much facilitated by following the plan adopted by Mr. Syme. In this gentleman's case the patient recovered, and the shoulder had motion in every direction.

Walther first demonstrated on the dead body the practicableness of amputating the scapula; and in one case, where this bone was inseparably connected with a tumour, the greater part of it was successfully removed by Haymann. (See *Walther, in Journ. für Chir.* b. v. p. 274.; and *Haymann*, vol. cit. p. 569.; *Chelius, Handb. der Chir.* b. ii. p. 759.) For a further account of the removal of diseased bones and parts of them, see BONES, EXCISION OF; and JOINTS, EXCISION OF.

AMPUTATION OF THE FINGERS AND OTHER PARTS OF THE HAND.

Amputation of the fingers, or parts of them, is performed with one, or with two flaps, or with a circular or an oval incision, and frequently required, either primarily or secondarily, on account of various accidents and diseases, as comminuted fracture, onychia maligna, necrosis, &c. The best surgeons all agree with Mr. Sharp, that in general the operation is most conveniently performed in their articulations, though exceptions sometimes occur in which it may be done elsewhere, and the phalanx divided with the cutting pliers. Thus it occasionally happens that either the distal or the middle phalanx is torn off, and the end of the proximate phalanx exposed: here, instead of removing the whole of the middle or of the proximate phalanx (as the case may be), it will often suffice to take away the denuded portion of it with the cutting pliers, and save a proper flap for covering the end of the remaining part. As Mr. Liston has explained, it is sometimes desirable to save as much as possible of the proximal phalanx, when amputation is rendered necessary by disease of the middle articulation, or of the distal extremity of the bone. In such cases, two semicircular flaps are made by cutting from without, either on the lateral, or on the palmar and dorsal aspects; and the bone is divided either with a small saw, or the cutting pliers. (*Elements, &c.* part iii. p. 374.) When an injury just includes the joint, and no more, Mr. Guthrie deems it better to saw through the bone, than to operate at the next articulation. (*On Gunshot Wounds*, p. 384.)

Amputation of the Distal and Middle Phalanges.

The distal bones are but loosely supported by the anterior ligament, and behind by the extensor tendon: at the sides, however, they are much more closely held together by the lateral ligaments. Consequently, it is these which must be divided, in order to lay open the joint freely. The line of the articular interval is nearly transverse. Between the distal and middle phalanx, it is on a level with the palmar cutaneous furrow; but, in the articulation of the middle with the proximate phalanx, it is a line and a half below the palmar furrow. (See *J. F. Malgaigne, Manuel, &c.* p. 305.) In either of these joints the operation is done in a very similar manner; either with a single flap, taken from the palmar surface of the finger, and long enough to cover the whole surface of the wound, or with two flaps, the longer one being formed on the palmar side, and the shorter one on the back of the finger. The surgeon, taking hold of the finger and placing it in the bent position, makes, with a narrow bistoury, an incision (I should say a semilunar one) across the prominence of the articulation; or, as Malgaigne directs, half a line below it. Thus the skin is divided, and the posterior part of the capsule generally opened with the same stroke. If it be not, the surgeon, without stopping to effect this, may proceed to cut the lateral ligaments, one after the other; and the knife being next conveyed through the articulation, the operation is completed by the formation of the palmar flap, which is to be the larger of the two, and long enough to cover the greater part of the wound. (See *Dupuytren, Leçons Orales de Clinique Chir.* t. iv. p. 305.; *Malgaigne, Manuel, &c.* p. 306.) When both phalanges are to be removed, the dorsal incision should end on each side, precisely on a level with the terminations of the cutaneous palmar furrow.

Another method, ascribed to Lisfranc, consists in attacking the joint on its palmar side. All the fingers are bent, except that which is about to be amputated. The point of a narrow straight bistoury, with the edge directed towards the extremity of the finger, is introduced half a line beyond the palmar cutaneous wrinkle, if we are amputating the distal phalanx; and exactly at the base of this wrinkle, if we are removing the middle phalanx. The knife is to pass through the finger from one side to the other, and close to the lateral and anterior surfaces of the bone; along which it should be carried to the extent of six lines, and then brought out, so as to complete a semilunar flap. The knife is then carried again to the base of the flap to divide the anterior ligament. In this operation the lateral ligaments scarcely require to be cut separately; for, the same stroke of the knife by which the anterior ligament is cut usually cuts them also, and makes room for the knife to be conveyed through the articulation. Lastly, the textures on the dorsal aspect are divided, without any posterior flap being made. By this method, a more regular and better nourished flap is produced, and the operation is more sure of being effected with precision; but the extensor tendon is apt to remain too long, in which event its projecting end should be cut off with scissors.

The *circular method* of amputating a finger is the oldest. The finger is put in the extended posture; a circular incision is made three or four lines beyond the articular interspace, the situation of which is denoted by the position of the palmar cutaneous furrow. The skin is dissected up as far as necessary, and the joint opened either in front or behind, as in the flap-operation already described. Or, if the disease or injury will admit of it, the integuments may be drawn up before the circular cut is made, and thus little or no dissection of them from the subjacent parts will be necessary. In general, after amputation of the distal and middle phalanges, the bleeding ceases as soon as the wound is brought together with adhesive plaster, and no ligature is required.

Amputation at the Metacarpo-phalangian Articulations.

Each of these joints is of the enarthrosis kind, and furnished only with loose ligaments. What is termed the knuckle, or the articular prominence, seen when the phalanx is bent, is formed by the head of the metacarpal bone. The joint is commonly about ten or twelve lines above the digital commissure.

1*st Method.*—The hand being placed in the prone position, and the other fingers held apart from the one about to be removed, the phalanx is to be bent, as Lisfranc specifies, to an angle of 45°, and an incision begun over the head of the metacarpal bone, about three lines beyond the articulation, and extended obliquely down to the side of the finger, on a level with the digital commissure, care being taken to divide as completely as possible the extensor tendon. The incision is then carried to the palmar aspect of the joint, and the first flap completed, which is to be reflected. The knife is now pushed into the exposed side of the articulation, the ligaments cut, and the operation finished by the formation of the opposite flap, which ends like the first at the digital commissure.

The following is Mr. Liston's description of this method: — The operator seats himself before the patient; grasps the finger so as to manage its movements with the left hand; and holding the knife perpendicularly, with its point upwards, lays it over the knuckle, and carries it obliquely upwards, so as to open that side of the articulation. He then pushes the finger towards the opposite side, and with the point of the knife completes the loosening of the articulation, which should never be done with the blade, as it would cross-cut and mangle the skin. After the separation of the base of the phalanx with the point, the blade is passed behind; and, being carried downwards and outwards, it forms a flap similar to the first. They are retained in contact by bringing the neighbouring fingers towards one another. In general, this will also stop the bleeding, but sometimes one or both digital arteries will require ligature. (See *Liston's Elements*, part iii. p. 375.)

When this operation is done on the index finger, the outer flap should be the larger; when on the little finger, the inner flap should have the greater size. (See *J. F. Malgaigne, Manuel, &c.* p. 310.) Dupuytren, instead of cutting the integuments obliquely, preferred dividing them perpendicularly, and making a semilunar incision, directed from the dorsal towards the palmar aspect of the finger. Another semilunar flap was next formed on the opposite side. As Dupuytren found that, when the ring or middle finger had been removed, without taking away the head of the corresponding metacarpal bone, the adjoining fingers remained widely separated at their base, but obliquely approximated to one another at their extremities, so as to produce a considerable deformity, and an imperfection in their functions, he used not to be content with amputating the phalanges, but made it a rule to apply a retractor, and saw off the head of the metacarpal bone. (See *Leçons Orales, &c.* t. iv. p. 309.) I know that Sir Astley Cooper has long advocated the same practice, which is most readily accomplished with a pair of strong cutting pliers. The extension of disease to one of the metacarpo-phalangian articulations may also be another reason for taking away more or less of the metacarpal bone along with the finger. If merely the distal end of the bone is affected, the foregoing plan of operation will suffice; but, as is remarked by Mr. Liston, if a considerable portion of the metacarpal bone is to be taken away, the palm should be left uninjured. "With this view the knife is entered over the dorsal centre of the bone, above the diseased part, and carried straight downwards till near the articulation, when it is made to diverge for the formation of lateral flaps. The integuments in the track of the wound are then dissected backwards, so as to expose the bone completely, and the bistoury is passed round it throughout its whole extent, the edge being kept close to it. Then the bone is clipped at the proper point by the cutting pliers; or the section of the bone may be performed before the separation of the soft parts from its under surface, as by raising the cut end this part of the operation may be facilitated." (See *Liston's Elements*, part iii. p. 377.)

Amputation of the Thumb.

If merely the anterior extremity of the metacarpal bone were diseased, the bone might be divided with the cutting pliers, so as to remove the part affected, amputation being done either with the circular incision or a flap. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 389.) An operation more frequently practised, however, is disarticulation at the joint between the metacarpal bone of the thumb and the os trapezium. The metacarpal bone is almost subcutaneous at its posterior and external aspect, but covered by a thick mass of muscle on the side towards the palm. The direction of the articulation is oblique, corresponding to a line, which, if carried far enough, would cross the root of the little finger. It has a loose capsule, and may be opened with the greatest facility at its two posterior thirds. The tendons of the long abductor and short extensor lie over the superficial side of it. The radial artery runs over its ulnar side in its way to the palm, to form the deep palmar arch. The tendon of the long extensor lies behind, and that of the long flexor in front of it. The place of the joint is readily determined by passing the forefinger over the dorsal aspect, or the sides of it, from before backwards, for it is situated immediately behind the first bony tubercle. (See *Velpeau, Op.* cit. p. 390.)

1*st Method.*—While the thumb is held in the position of abduction, the knife is applied to the middle of the commissure; an incision is made at once down to the carpus, the edge being carried close to the ulnar side of the metacarpal bone, which is about to be taken away; the joint is then opened by cutting outwards, the fibrous textures divided rather with the point than the blade, so as not to cross-cut the skin; the thumb abducted and dislocated, and a flap formed from behind forwards, by carrying the knife close to the outer side of the bone, and a few lines beyond the metacarpo-phalangian joint. If the radial artery itself has been wounded, it must have a ligature; but, in other cases, bringing the flap accurately over the wound will stop the bleeding. Besides applying adhesive plaster, the flap, and especially its base, should be supported with a compress and bandage.

2*d Method.*—An assistant takes hold of the thumb, while the surgeon takes as much of the soft parts as possible with the fingers of his left hand, and draws them outwards. The latter then transfixes them with a straight narrow knife from behind forwards, or towards the palm, directing the blade close to the radial side of the articulation. A flap is then formed; and while this is held up by the assistant, the surgeon takes hold of the thumb, cuts through the joint from without inwards, luxates the bone, and with the knife cuts through the middle of the commissure. This method leads to the same result as the former, but, being more difficult, ought not to be preferred.

3*d Method.*—Velpeau has frequently amputated the thumb in the following manner:—An incision is made along the back of the thumb from the styloid process of the radius to the commissure of the thumb and forefinger. This divides the integuments, the tendon of the long extensor, and a portion of the first interosseous muscle, so as to expose the joint. While an assistant holds aside the edges of the wound, the surgeon opens the capsule and dislocates the bone, which is then removed, care being taken to preserve as much of the flesh on the palmar side as will be required to close the wound immediately. Thus the palm of the hand is not at all wounded.

4*th or Oval Method.*—The operation is begun as in the foregoing plan. The knife is carried round the anterior aspect of the root of the thumb, and then over the dorsal one, this second cut joining the extremity of the first. The point of the knife is next introduced into the articulation, which is cut through from its dorsal towards its palmar boundary. All that now remains to be done is to detach the bone from any fibres which may yet adhere to it, by carrying the knife in front of it from behind forwards. The wound, when brought together, represents a straight line. (See *Velpeau, Op.* cit. p. 392.) This method was described by Lassus, Beclard, &c.

Amputation of the Phalanges of the Thumb.

Needs no particular description, as it is performed in the same way as the removal of the middle and last phalanges of the fingers.

Amputation of the Middle Finger or Ring Finger, together with the whole of the Metacarpal Bone.

A few years ago Langenbeck first removed by the oval method the middle finger, with its metacarpal bone, from the os magnum. In order to find out the articulation, he draws a line from the upper head of the metacarpal bone of the thumb straight across to the metacarpal bone of the finger about to be removed; and at this place he begins his first incision, which runs towards one of the digital commissures. From the point where this is begun another cut is made down to the outer commissure, and the two united by carrying the knife round the palmar aspect. While an assistant holds apart the sides of the wound, the surgeon cuts the ligaments of the joint with the point of the knife, and at the same time endeavours to dislocate the bone with his left hand. This having been accomplished, the knife is introduced flat under the carpal end of the metacarpal bone, and all the connections of the bone towards the palm divided from the carpus to the root of the finger. (See *Langenbeck's Bibl.* b. i. p. 575. and plate iii. fig. 1.) It is often difficult to know, however, whether the disease is confined to the metacarpal bone; and, if it be not, and the carpus be affected, the operation will not answer, as was exemplified in one of Langenbeck's own cases.

Amputation of the Little Finger, with a Part or the Whole of its Metacarpal Bone.

A flap is formed by transfixion at the inner side of the joint or part where it is intended to saw through the bone, and by carrying the knife a little beyond the level of the opposite digital commissure. The joint is then opened, the bone separated from the soft parts, and its detachment completed by division of the commissure. If only a portion of the metacarpal bone is to be removed, the cutting pliers are the best instrument for its division.

Modern surgeons never amputate the whole of the hand, when there is a reasonable chance of preserving any useful portion of it. Thus, when a soldier had been struck by a grape shot, which shattered the metacarpal bones of the little and ring fingers, grazed the middle finger, and tore the integuments on the palm and back of the hand, Mr. Guthrie succeeded in saving the two fingers and thumb, although in the removal of the other parts no regular flaps could be made for covering the wounds. (*On Gunshot Wounds*, p. 382.) In the North London Hospital, assisted by Mr. Liston, I also succeeded, in the spring of 1835, in saving the hand and a couple of fingers, after a severe laceration and comminution of this part of the limb by machinery. The thumb and other injured fingers were amputated.

On this principle of removing as little of the upper extremity as possible, amputation of all the fingers together at the metacarpo-phalangian articulation is sometimes practised with a single or double flap.

Amputation of Parts of the Foot.

It may happen that the bones of the toes, and only part of the metatarsal bones, are carious, in which case the leg need not be cut off, but only so much of the foot as is disordered. Mr. Liston's cutting-bone forceps will often be found exceedingly useful in such an operation, where it may be necessary to divide a phalanx or the metatarsal bone. When this operation is performed, the heel and the remainder of the foot will be of great service, and the wound heal up safely, of which Mr. S. Sharp says he had seen one example. (*Op. of Surgery*, chap. 37. ed. 3.) Mr. Hey confirms this statement of Sharp's concerning the impropriety of removing the whole foot, when the metatarsal bones are carious and every other part of the leg is sound, as the remainder of the foot is of immense service in walking, the use of the ankle not being destroyed.

Mr. Hey proposed a new mode of removing the metatarsal bones, which on repeated trial fully answered his expectations. By the term NEW, I here mean a particular method, which had not been previously described, though it may have been performed by others sooner than by Mr. Hey himself; for the merit of having first done it is imputed to the late Mr. Turner, of North Yarmouth, who did it with success about the year 1787. (See *Hutchison's Prac. Obs.* p. 70.) Mr. Hey makes a mark across the upper part of the foot, to denote where the metatarsal bones are joined to those of the tarsus. About half an inch from this mark, nearer the toes, he makes a transverse incision, through the integuments and muscles covering the metatarsal bones. From each extremity of this cut, he makes an incision along the inner and outer side of the foot to the toes: he removes all the toes from the metatarsal bones, and then separates the integuments and muscles, forming the sole of the foot, from the inferior part of the metatarsal bones, keeping the edge of the knife as near the bones as possible, in order to expedite the operation, and preserve as much muscular flesh in the flap as can be saved. He then separates the four smaller metatarsal bones, at their junction with the tarsus, and divides with a saw the projecting part of the first cuneiform bone, which supports the great toe. The arteries being tied, Mr. Hey applies the flap, which had formed the sole of the foot, to the integuments which remain at the upper part, and keeps them in contact with sutures. The cicatrix being situated at the top of the foot, is in no danger of being hurt; while the place, where the toes were situated, is covered with such strong skin, viz. what previously formed the sole of the foot, that it cannot be injured by any moderate violence. (See *Practical Observations in Surgery*, p. 535, &c.)

When the metatarsal bone of the great toe is alone diseased, Mr. Hey recommends dissecting it out from the cuneiform bone, instead of sawing it. The latter plan cannot be easily accomplished, without removing part of the integuments and muscles, and making a transverse, as well as a longitudinal, incision. These disagreeable things may be avoided, however, by employing the cutting pliers, or by following the method of Mr. Hey, or that of Sir Charles Bell. For removing the metatarsal bone, either of the little or great toe, the latter gentleman directs us to carry a scalpel round the root of the toe, and then along the side of the foot. The flaps are then to be dissected back, the metatarsal bone is to be separated from the next, and its square head is to be detached from the tarsus. (*Operative Surgery*, vol. i. p. 390.)

The plan of removing the metatarsal bone of the great or little toe, and leaving the toe itself, is now renounced. Mr. Liston has seen it done, but the result was unsatisfactory. (*Elements, &c.* part iii. p. 398.) The late Mr. Hewson, of Dublin, removed the first metatarsal bone from the foot of a patient in the Meath Hospital, and allowed the great toe to remain. The wound healed, and the patient was dismissed cured; but, in a few months, he returned to the hospital, complaining that he could not use the foot on account of the position which the great toe had assumed. It was drawn downwards and outwards, and lay transversely under the second and third toes, both which were in a state of ulceration, where they were in contact with it. No power of moving the toe was recovered. (See *Rynd, in Dubl. Journ. of Med. Science*, vol. viii. p. 297.)

Dupuytren objects to the usual method of amputating the great toe at the metatarso-phalangian articulation, because, as he states, the head of the metatarsal bone forms, after the operation, a very prominent angle at the inner side of the foot, impeding the bringing of the margins of the wound together, and causing ulceration, &c., from pressure of the shoe on the part after cicatrization. Hence, instead of disarticulating the great toe, Dupuytren prefers amputating in the continuity of the metatarsal bone. In the trials which he made of this plan, the loss of the point of the tripod of the foot, caused by the removal of the head of the metatarsal bone of the great toe, was not followed by any inconvenience. (See *Leçons Orales de Clinique Chir.* t. iv. p. 336.)

The best way of executing either of these operations seems to me to consist in transfixing the soft parts, and making a flap at the inner side of the toe; disarticulating the phalanx from the metatarsal bone, or dividing the latter with Mr. Liston's cutting forceps, and then completing the detachment by cutting the soft parts from the bone, and at the commissure. Dupuytren followed a more complicated plan, and was not in the habit of using the cutting forceps, by which the operation is so materially facilitated. The plan which I have recommended, is also applicable to amputation of the little toe, with a part or the whole of its metatarsal bone.

In winter campaigns, the toes, and more or less of the foot, are often attacked with mortification from cold. In this circumstance, when the disorder does not extend beyond the middle of the foot, or the toes, it is only necessary to cut away the gangrenous part. On the first entrance of the French army into Holland after the revolution, Paroisse met with many of these cases, in which it was requisite merely to take away the metatarsal bones, or sometimes those of the tarsus. All the patients, operated upon in this manner for the effects of cold, were cured; walking afterwards with more or less difficulty, according as the portion of the foot taken had been greater or smaller. (*Opuscules de Chir.* p. 218.)

The method of removing a part of the foot at the junction of the two halves of the tarsus, or Chopart's operation, is one of considerable merit. It is performed in the nearly parallel articulations of the os calcis with the os cuboides, and of the astragalus with the os naviculare. Thus the heel is preserved, on which the patient can afterwards walk. The performance of it is simple. The tourniquet having been applied, the surgeon is to make a transverse incision through the skin which covers the instep, two inches from the ankle joint. He is to divide the skin, and the extensor tendons, and muscles, in that situation, so as to expose the convexity of the tarsus. He is next to make on each side a small longitudinal incision, which is to begin below and a little in front of the malleolus, and is to end at one of the extremities of the first incision. After having formed in this way a flap of integuments, he is to let it be drawn upward by the assistant who holds the leg. There is no occasion to dissect and reflect the flap; for the cellular substance connecting the skin with the subjacent aponeurosis is so loose, that it can easily be drawn up above the place, where the joint of the calcaneum with the cuboides, and that between the astragalus and scaphoides, ought to be opened. The surgeon will penetrate the last the most easily, particularly by taking for his guidance the eminence, which indicates the attachment of the tibialis posticus muscle to the inside of the os naviculare. The joint of the os cuboides and os calcis lies pretty nearly in the same transverse line, but rather obliquely forward. The ligaments having been cut, the foot falls back. The bistoury is then to be put down, and the straight knife used, with which a flap of the soft parts is to be formed under the tarsus and metatarsus, long enough to admit of being applied to the naked bones so as entirely to cover them. It is to be maintained in this position with three or four strips of adhesive plaster, which are to extend from the heel, over the flap, to the inferior and anterior part of the leg. On the instep, the continuation of the anterior tibial artery will require a ligature; and in the sole, the internal and external plantar arteries, in the thickness of the flap of soft parts, must generally be taken up. One half of each ligature is to be cut away, and the other one is to be left hanging out between the plasters, at the nearest and most convenient point.

Walther and Graefe have given some very precise directions for the performance of this operation. A cut is first made, beginning half an inch below the outer ankle, and extending forwards along the side of the foot two inches. Another similar incision is then made, beginning one inch below the inner ankle. The foot is now to be bent upwards, and the two first cuts united by a transverse incision, two finger-breadths from the front of the tibia. A flap is then dissected up, as far back as the commencement of the lateral incisions, or a line corresponding to the articulation of the astragalus with the os naviculare, and of the os calcis with the os cuboides. An assistant now checks the bleeding by applying the points of his fingers on the mouths of such vessels as bleed profusely, and holds up the flap. The extremity of the foot is then to be firmly inclined downwards, so as to stretch the ligaments connecting the tarsal bones together. The ligaments between the astragalus and os naviculare are to be first cut, when the foot may be twisted somewhat outwards, and the ligaments between the os calcis and os cuboides divided. Lastly, the operation is completed by cutting through the soft parts regularly from above downwards, with the precaution of directing the amputating knife so as to leave a flap composed of part of the sole of the foot. (See *Abhandl. aus dem Gebiete der Prakt. Med. &c.* Landshut, 1810. b.i. p. 152.; and *Graefe, Normen für die Abl. grösserer Gliedm.* p. 142.)

Sometimes, in consequence of the soft parts of the instep being all gangrenous or otherwise destroyed, it is necessary to make the flap entirely from the sole of the foot, as Klein was obliged to do in one of his cases. (*Practische Ansichten bedeutendsten Chir. Operationen*, h. i. p. 28.) Indeed, Richerand thinks this mode generally advantageous, as the line of the cicatrix is not placed at the lower end of the stump, where it would be most exposed to injury. (*Nosogr. Chir.* t. ii. p. 502, &c. ed. 4.) Langenbeck and Klein also disapprove of raising the flap from the instep, as advised by Walther and Graefe. Chopart himself, as we have seen, merely drew back the integuments of the instep, without making any detachment of them from the subjacent parts. When the ends of the flexor tendons of the toes project too much from the inner surface of the lower flap, they are to be cut off, as Klein particularly directs; and I consider his advice not to use sutures for keeping the flap applied, but merely strips of sticking-plaster, perfectly judicious. (*Op.* cit. p. 33, 34.) I have seen several patients who had undergone Chopart's operation, and afterwards walked exceedingly well. A black man was lately shown to me by my friend, Mr. Copland Hutchison, who had performed the operation; and in reality scarcely any limping was perceptible.

I mention these facts, because Dupuytren may have expressed himself rather too strongly against Chopart's operation, when he says, that the removal of a part of the tarsus deprives the patient of a point of support essential in walking and standing, and renders the limb nearly useless. He asserts likewise, that, as the attachments of the tibialis anticus and tibialis posticus, the antagonists of the gastrocnemius and soleus, are divided, the heel becomes drawn considerably upwards. For these reasons, and because the nervous and inflammatory disturbance was found by him to be great after Chopart's operation, Dupuytren preferred partial amputation of the foot in the tarso-metatarsian articulations; and insisted on the rule of not cutting any further backwards than the circumstances of the disease or injury required. The latter method is alleged to have been practised as early as 1720. Certainly it was executed by Percy in 1789, and by Hey in 1799. (See *Clinique Chir.* t. iv. p. 346.)

Mr. Whatton disapproves of both the preceding modes of removing parts of the foot; and, when the circumstances of the case will allow, preserves a greater portion of the limb. In one case, an incision, commencing at the root of the fourth toe, was carried in a slightly curved direction towards the extremity of the fifth metatarsal bone, and made to terminate near the outer malleolus. This incision was on the plantar surface. A similar incision, commencing and terminating at the same points, was carried along the dorsum. The flaps being raised, the knife was carried between the two outer metatarsal bones down to the cuboid. The outer edge of the os calcis, being found diseased, was pared off with a scalpel. The second incision removed the next toe, and its metatarsal bone, in a similar manner, leaving three toes with their corresponding metatarsal bones. The hemorrhage was so copious, that the dressings were not applied till the patient had been put to bed. The man was well in twelve weeks; and, after a time, seemed to have the perfect use of the limb. (See *Dubl. Journ. of Med. Science,* vol. viii. p. 193.)

Many years ago, Mr. Dunn, of Scarborough, communicated to me the particulars of a case, in which he removed the cuboid and external cuneiform bones; and a month afterwards, took away from the same patient the os naviculare and the two other cuneiform bones, and sawed off the diseased tarsal extremities of the metatarsal bones of the second and third toes. A deluge of blood followed the operation, and the boy fainted. As soon as the syncope went off, Mr. Dunn scraped away some part of the astragalus, which was found to be diseased. Dry lint and a roller put a stop to the hemorrhage; but some secondary bleeding occurred, and it was necessary to secure the dorsal artery of the foot. In about five months, the boy was completely well, and able to walk without any pain, and with very slight lameness. (See *Med. Chir. Trans.* vol. ii. p. 337, &c.) From a note affixed to Mr. Dunn's essay, it appears, that Mr. A. Copland Hutchison obviated all occasion for amputation of an officer's foot, by extracting the fragments of two bones of the tarsus and three of the metatarsus, which had been broken by a musket ball. (P. 346.; also *Hutchison's Practical Obs. in Surgery,* 8vo. Lond. 1816.) On this subject, I fully concur with Mr. Hutchison, that, when the foot is extensively diseased, partial amputation of the foot will generally be more prudent than attempts at excision of the diseased bones. In Mr. Dunn's case, however, as every bone of the tarsus was affected, except the os calcis, partial amputation of the foot was out of the question. Either excision of the diseased bones, or amputation above the ankle, was the only alternative.

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AMYLUM. Starch is occasionally employed in clysters. The following is the formula used at St. Bartholomew's Hospital. ℞ Mucilaginis Amyli, Aquæ distillatæ, sing. ℥ij; Tinct. Opii guttas quadraginta: Misce. When the starch enema is employed with laudanum for the relief of retention of urine, it is very desirable that it should be retained in the rectum a certain time, in order that it may have the desired effect. This purpose will be more likely to be fulfilled, if the quantity of mucilaginous fluid injected do not exceed two or three ounces.

ANASTOMOSIS (from *ανα*, through, and *στομα*, a mouth). Anatomists and surgeons imply, by this term, the communications of the blood-vessels with each other, or their running and opening into each other, by which the continuance of a free circulation of the blood is greatly ensured, and the danger of mortification lessened. The immense importance of this part of our structure, in all cases in which the main artery, or veins of a limb are obliterated, is particularly conspicuous in the disease called aneurism. (See Aneurism.)

Nay, such has been the providence of nature in this respect, that, even where the thoracic aorta has been completely obstructed, the channels for the conveyance of the blood to the lower extremities have yet been found adequate to that purpose. This was proved in an example where the obstruction had been gradually produced by disease, and the anastomosing vessels of course had had time for enlargement; for this is a very different case from that in which a ligature is suddenly applied to the aorta; though, as far as can be deduced from the particulars of some experiments made on dogs by Sir Astley Cooper, and of three operations in which the human abdominal aorta has been tied by him (*Surgical Essays*, part i. p. 101.), by Mr. James, of Exeter (*Med. Chir. Trans.* vol. xvi.), and Mr. Murray, at the Cape of Good Hope, blood will still pass to the lower extremities in sufficient quantity for their nutrition. At least, this inference is safely deducible from the very memorable operations to which I have referred, subject to one important condition, viz. that there be no additional cause of impediment to the passage of blood to the lower extremities besides the ligature above the bifurcation of the aorta. When Sir A. Cooper tied the human aorta in the abdomen, the experiment was made as the only possible means of hindering a man from bleeding to death, who had a large aneurism of the external iliac artery actually beginning to bleed, and extending too high to admit of any thing else being done. Now, although the unfortunate patient was not saved, and it must be acknowledged that the chances of any other result were very small, the case furnished the important proof, that if the abdominal aorta be suddenly and completely obstructed, the blood may yet pass in adequate quantity to the lower extremities, *provided there exist no other cause of impediment to the passage of the blood into them*; for, on the side occupied by the aneurism, the circulation in the limb was stopped, while, in the opposite limb, the circulation and natural warmth were preserved. To this subject I shall hereafter return. (See Aorta.)

The changes which take place in the arterial system of the limb, when the main artery is rendered impervious by the application of a ligature, are well described by Mr. Hodgson: "The blood, meeting with an obstacle to its progress through the accustomed channel, is thrown in greater quantity, and with greater force, into those branches which arise above the seat of the obstruction. The ramifications of these branches, in consequence of the unusual influx of blood, undergo a remarkable dilatation; the more minute vessels also, by which they anastomose with corresponding ramifications, arising from branches given off below the obstruction, are from the same cause sufficiently enlarged to allow a free passage of the blood into the inferior trunks of the limb. At first, the circulation is in this manner carried on through a congeries of minute anastomosing arteries: in a short time, a few of these channels become more enlarged than the rest: as these increase in size, the smaller vessels gradually collapse, and ultimately a few large communications constitute permanent channels, through which the blood is transmitted to the parts that it is destined to supply. This is one mode by which a collateral circulation is established.

"But, in some situations, more direct and ostensible inosculations are provided; so that when one channel is obstructed, the blood passes at once through the other in a sufficient stream for the nourishment of the part which it is destined to supply. Under these circumstances, no dilatation of the collateral branches is necessary: the circulation, in such instances, may be said to be constantly carried on through inosculating trunks. These great communications principally exist in the extremities of the body, where the dilating impulse, which the blood receives from the heart, is of course diminished. Thus, the radial artery inosculates freely with the ulnar; the anterior with the posterior tibial; and the internal carotid with the vertebral arteries. Two modes therefore exist, by which arteries communicate with each other — the anastomoses of minute ramifications, and the direct inosculations of trunks." (See *Hodgson on the Diseases of Arteries and Veins*, p. 234. Refer also to Inosculation.) The best general account of the inosculations, in relation to aneurism, is contained in Scarpa's *Treatise on Aneurism*; more especially the Italian edition, which is embellished with beautiful engravings.

ANCHYLOSIS (from αγκυλος, crooked). *True* or *complete* anchylosis signifies the fixed and motionless state of a joint, resulting from the articular surfaces being consolidated together by osseous matter. *False* or *incomplete* anchylosis denotes the loss of motion, or very considerable rigidity, in an orbicular, or ginglimoid joint, occasioned by adhesions of one synovial surface to the other, or by a thickening of the soft parts on the outside of the joint. By Mr. Mayo, anchylosis is divided into *osseous, cartilaginous*, and *mixed*, according as the articular surfaces happen to be united through the medium of bone, of cartilage, or of both these substances together. (See *Outlines of Human Pathology*, p. 72.) Of course, this last classification is not intended to comprise some of the varieties of false anchylosis. True anchylosis, then, may be said to denote an intimate osseous consolidation, either of the kind of joint termed *diarthrosis*, where the ends of the bones are tipped with cartilage, and furnished with a capsular ligament, or of the other less moveable sort of joint, termed *synarthrosis*, where the bones are united by an intervening layer of fibro-cartilage, and the articulation is strengthened externally by ligamentous bands. The latter kind of joint can hardly be said to be susceptible of false anchylosis; for it naturally has only a very slight degree of motion, which requires a true anchylosis for its interruption.

Anchylosis is more common in the ginglimoid articulations than others; though sometimes met with in every description of joint. In general, only one joint is anchylosed in the same individual; but sometimes several articulations are the seat of anchylosis, and rare instances are recorded, in which every joint in the body was in this state. Thus, Bernard Conner describes an example of a general anchylosis of all the bones of the human body. (*De stupendo Ossium Coalitu.*) The particulars of a child, twenty-three months old, afflicted with universal anchylosis, are given in *L'Hist. de l'Acad. des Sciences*, an. 1716. In old age, anchylosis in certain parts of the skeleton is a natural change; and in this period of life, it is common to find the heads of the ribs anchylosed to the bodies of the vertebræ, or the tubercles to the transverse processes, the vertebræ to one another, the enciform cartilage to the sternum, &c.

Anchylosis, strictly speaking, is not a disease itself, but only an effect or consequence of other affections, and it may follow all those which destroy any one of the conditions, without which the motion of a joint is necessarily interrupted either permanently or for a very considerable time. The author of the article *Anchylosis*, in the *Encyclopédie Méthodique*, refers to a preparation, in which the femur is so anchylosed with the tibia and patella, that both the compact and spongy substances of these bones appear to be common to all of them, without any line of separation being discernible between them. Eustachius, Columbo, and Cruveilhier, have each seen an anchylosis of the lower jaw. In the Museum of the London University is a specimen of anchylosis extending to eleven vertebræ. In the same collection are examples of anchylosis between the occipital bone and the atlas, between the atlas and the dentata, and between the three upper cervical vertebræ. There may also be seen perfect anchyloses of the three bones of the knee, those of the elbow and hip, of the metacarpal bones to one another, and of the sacrum to the ischium. Cruveilhier has given the particulars of an anchylosis of one of the articulations of the lower jaw in a very old woman. It commenced in her childhood, from a blow on the side of the face. From the engraving of the parts, it appears that the condyle and glenoid cavity were completely consolidated and united by osseous matter.

Referring to anchylosis in general, we may observe with M. Sanson, that its causes are numerous; inasmuch as every circumstance capable of impairing the articular surfaces, stopping the synovial secretion, lessening the suppleness of the ligaments, or of the soft parts around the joint, or of interfering with the action of the muscles, or the play of the tendons, may hinder the articular surfaces, more or less, from moving upon one another. One thing, almost essential to the production of anchylosis, is the part being kept motionless; and, as M. Sanson well observes, this condition has such influence, that it will of itself bring on the changes which terminate in a joint becoming incapable of resuming its functions, in consequence of true or false anchylosis. An illustration of this fact is afforded by what happens to the Indian Fakirs, who, by way of religious penitence, sometimes condemn themselves to continue motionless in certain attitudes for several years, and whose limbs at the expiration of the term are anchylosed in the posture, in which they happen to have been so long maintained. The same fact is exemplified in persons who met with fractures of their limbs; for, in consequence of the motionless state in which the part is kept to promote union of the broken bones, the synovial secretion is diminished, and the fibrous capsules and ligaments of the joint all acquire a rigidity, in which the surrounding cellular tissue participates. The sheaths of the tendons are also no longer duly lubricated. All these circumstances make opposition to the free action of the muscles, which, being themselves weakened by protracted inactivity, are incapable of overcoming the resistance to the motion of the joint. On the same principle of a long-continued motionless state of an articulation, anchylosis may be induced as a complication and sequel of the contracted state of some particular muscle, or of the growth of various tumours near the joint. The contraction of cicatrices after burns, or after a destruction of the soft parts by gangrene or ulceration; and an unyielding state of the cellular tissue, the effect of extensive and inveterate abscesses in it; certain exostoses; and especially inflammation of the synovial membrane, whether acute, or chronic, idiopathic, scrofulous, or rheumatic, &c., or accidentally excited by mechanical injury of the joints; are all so many circumstances capable of leading to anchylosis. Particular fractures of the joints, or such as are situated near them, if not skilfully treated, are apt to be followed by inflammation of the synovial membrane, absorption of the cartilages, and complete anchylosis. No doubt, in some of these instances, the connection amounts at first only to what authors understand by false anchylosis; but, in the course of time, this becomes converted into complete, or true, characterised by osseous consolidation. On the whole, however, as M. Sanson has remarked, false anchylosis is far more common than the true form of it.

When a bone is fractured near a joint, and this is kept too long motionless, anchylosis is apt to follow. Here the risk is increased by the synovial membrane being likely to inflame; and, indeed, sometimes the accident brings on ulceration of the cartilages. In the North London Hospital, I lately saw a case, where the olecranon had been broken across its base, and the detached piece had become completely consolidated to the humerus; yet the patient had considerable power of extending the forearm, probably through the medium of the long supinator and other muscles arising from the outer condyle. It is partly in consequence of the risk of inflammation of the synovial membrane and of anchylosis, that fractures of or very near joints are more serious than others differently placed. Wounds and contusions of joints may bring on such changes as terminate in anchylosis. I have already mentioned, that Cruveilhier has seen an instance of anchylosis of the right articulation of the lower jaw. This was brought on by a blow received on the part when the patient (a female) was a child. She lived to a very advanced age, and, notwithstanding the anchylosis, was able to speak very well, and to masticate by pressing the food with her tongue against the hard substance covering the alveolary processes, where the teeth were deficient. (See *Cruveilhier, Anat. Pathologique,* livr. ix. pl. 5. figs. 1 & 2.)

With regard both to true and false anchylosis, the surgeon may generally render more efficient service in preventing, than in endeavouring to cure them. In wounds, contusions, and fractures of or near joints, the best means of prevention consist in the rigorous adoption of antiphlogistic treatment at first, and in a later stage in having timely recourse to passive motion of the joint; and then to combine with this plan friction with camphorated and other liniments, in order to promote the secretion of the synovia. When the bones are carious, as in scrofulous disease of the vertebræ, and in advanced stages of ulceration of the cartilages of the knee, elbow, wrist, &c., the surgeon, instead of endeavouring to prevent anchylosis, should promote its occurrence, as the most favourable result which the case now admits of. In fact, the completion of anchylosis will denote the termination of the disease. One important indication, however, under such circumstances, is to try to let the limb be anchylosed in the posture which will allow it to be of the greatest possible use. Thus, when the elbow is likely to be the seat of anchylosis, the forearm should be kept bent; but when the knee is concerned, the leg should be kept extended; and when the hip, the thigh should be maintained in a similar position. If anchylosis should have taken place to a certain extent, with the limb in a disadvantageous posture, this may often be still very much improved by the application of splints, and other mechanical contrivances. The action of any mechanical apparatus, however, must be at first moderate, though unremitting. Perseverance will here succeed, when violence would fail by bringing on excessive pain and a dangerous degree of inflammation. Indeed, where the attempts to remove a false anchylosis by gentle passive motion, embrocations, and the cautious use of mechanical means, fail, it is better not to employ violence, because such an anchylosis is preferable to inflammation, abscesses, and ulceration of the joint.

As for true anchylosis, where a complete osseous consolidation has taken place, it may be set down, not only as incurable, but as admitting of no improvement or alteration in the position of the limb, and, whatever that may be, the patient must be content with it. Hence, where there is risk of anchylosis, the great importance of placing the limb in good time in the position, which will let it be of the greatest service to the patient.

Mr. Barton, one of the surgeons to the Pennsylvania Hospital at Philadelphia, made, a few years ago, the bold attempt to cure an anchylosis of the hip-joint by a surgical operation. (See *North American Med. and Surg. Journ.* for April, 1827.) The patient was a young sailor, who had fallen into the hold of a ship, injured the hip, and remained seven months without surgical assistance. He was now admitted into the above hospital, under Mr. Barton. The injured thigh, which was the right one, was in the bent position, with the knee drawn across the lower part of the left femur. The outer edge of the foot was placed forwards, and the sole turned outwards. A suspicion of dislocation was immediately entertained; but so great was the swelling, and so acute the pain in the hip, that Mr. Barton was deterred from making a manual examination to ascertain the fact. As soon as these symptoms had subsided, the limb was kept for several weeks extended in an apparatus, but without producing any elongation, or change in its position. Indeed, a complete anchylosis between the femur and os ilium had taken place. After a year's consideration, Mr. Barton, seeing that the case was beyond all common means of relief, determined to attempt to make an artificial joint. For this purpose he made in the upper part of the thigh an incision six or seven inches long, the middle part of which corresponded to the great trochanter. The centre of this first cut was crossed by another four or five inches in length, at a right angle. These incisions divided, in succession, the skin, the fascia lata, and muscles, so as to expose the anterior and posterior part of the femur, between the great and little trochanters. The femur was then sawn through between the great trochanter and the neck of the bone. The operation was completed in seven minutes; and, as soon as it had been done, the limb was easily brought into its proper position again, and found not to be more than about half an inch shorter than the other. The wound, which bled but little, was now closed, and the limb put up in a suitable apparatus, with one of Desault's splints. At first, the inflammation, swelling, and inflammatory fever were severe; but in nine days these symptoms abated, and the wound suppurated favourably. Suffice it to add, that the patient could move his thigh in all directions, and was able to get up; and in four months he was able to walk a considerable distance. He could by this time move the foot twenty-four inches forwards, twenty-six backwards, and twenty laterally, and rotate it six inches inwards or outwards. The limb was strong, and so trivially shortened, that the patient walked very perfectly. Behind the new joint was a deposit of bone, supporting the femur in this direction, and preventing its dislocation. Although the successful result of Mr. Barton's operation is what his boldness fully deserved, I agree with M. Sanson in thinking, that doubts will be entertained by many judicious surgeons, whether the proceeding, which actually put the patient's life in jeopardy, was really indicated.

W. H. Müller, de Anchylosi, Lugd. 1707. L'Encyclopédie Méthodique, Partie Chir. t. i. art. *Anchylose. J. L. Petit*, Traité des Mal. des Os, t. ii. *J. T. Van de Wynpersse*, De Ancyloseos Pathologia et Curatione, singularibus observationibus et fig. illustr. 4to. Lugd. 1783. Gentleman's Magazine, 1787; Universal anchylosis, ligaments ossified. *Wurz*, Wundarzn. p. 224., following the removal of the patella. *Sandifort*, Exercit. Acad. p. i. &c.; anchylosis of the occiput with the atlas, and of the atlas with the dentatus. *Sandifort*, Obs. Pathol.; anchylosis of the jaw. *Dumas*, Recueil Périodique de la Société de Méd. t. x. p. 30. and t. xiii. p. 352. *Hennen's* Principles of Military Surgery, p. 161, &c. ed. 2. The examples of general anchylosis are numerous: *Ploucquet* refers to *Columbus* de Re Anatomicâ; *Connor*, De stupendo Ossium Coalitu, Oxon, 1695; *Deslandes*, in Mém. de l' Acad. des Sciences, 1716; *Frank*, Reise nach Paris, London, &c. p. 127., anchylosis of all the joints except those of the lower jaw; *Olivier*, in Journ. de Méd. t. xii. p. 273.; *Voigt*, Mag. für den Neuesten Zustand der Naturkunde, 4 b. p. 412.; *Portal*, Cours d' Anat. Méd. t. i. p. 14.; Phil. Trans. No. 461.; *J. C. Smith*, Nat. Hist. Hiberniæ Comit. 1744. *Job à Meckren's* Obs. c. 64. p. 297. *Callisen*, Systema Chir. Hodiernæ, t. ii. p. 699. edit. 1800. *Boyer*, Mal. des Os, t. ii. et Traité des Maladies Chir. t. iv. p. 553. *Verduc*, Traité des Bandages, chap. xxxv. p. 172. *Richerand*, Nosogr. Chir. t. iii. p. 223. edit. 4. *Murray*, Diss. de Anchylosi. Upsal, 1797. *Cruveilhier*, Anatomie Pathologique, t. i. Paris, fol. 1829—1835. *A. Sanson*, Dict. de Méd. et de Chir. Pratique, art. *Ankylose.*

ANUERISM, or ANEURYSM (from ἀνευρύσμα, a dilatation). The tumours which are formed by a preternatural dilatation of a part of an artery, as well as those swellings which are occasioned by a collection of arterial blood, effused in the cellular tissue, in consequence of a rupture, or wound of the coats of the artery, but having no outlet in the integuments (see *Guthrie on Dis. of Arteries*, p. 46.), receive the name of aneurisms. According to these opinions, aneurisms are of two kinds; the first being termed *true;* the second *spurious*, or *false.* Some modern writers reckon another form of aneurism, which is said to happen, when the external coats of an artery being weakened by mechanical injury, or disease, the internal coat protrudes through the breach in the outer coat, so as to form a tumour distended with blood. This case has been denominated the *internal mixed aneurism*, or *aneurisma herniam arteriæ sistens.* The reality of this form of disease was believed in by Dr. W. Hunter; and some delicate experiments, instituted by Haller on the mesenteric arteries of frogs, appear to have been the first ground of the opinion. Such an aneurism, however, has not been universally admitted: not that any body doubted the correctness of what Haller advanced; but because there might not always be a perfect analogy between the results of an experiment on animals, and those afforded by the observation of the diseases of the human body.

When Haller asserted, that, by separating the muscular from the inner coat of the arteries, he could, when he pleased, produce an aneurism in these animals; and when Hunter declared, that such an experiment made the artery firmer than ever, in consequence of the adhesive inflammation taking place; the character and veracity of these eminent men naturally lead to the question, whether the experiments were conducted exactly in the same manner. Now, says Mr. Wilson, when we know that Haller did not suffer the surrounding parts to unite, and that John Hunter did, we can no longer be at a loss to account for the different conclusions. (See *Wilson's Anatomy, Pathology, &c. of the Vascular System*, p. 378.)

However this may be, with respect to the experiments made on certain animals, I am disposed to consider it fully proved by Mr. J. Hunter, Sir E. Home, and Professor Scarpa, that, in the human subject, an aneurism will not arise from the kind of weakness which is caused by cutting or even stripping off the external coat of a sound artery, whether the wound be closed or not.

This fact would at least appear to be well established, with respect to the generality of the arteries; but, how far it is so in relation to the aorta, is another question, the inner membrane of which vessel is more elastic than that of common arteries. Indeed, in 1804, Dubois and Dupuytren presented to the Faculty of Medicine at Paris, a pathological preparation, exhibiting the lining of the aorta protruding through the middle coat, in the form of a sac filled with blood. (See *Dict. des Sciences Méd.* art. *Aneurisme;* and *Breschet, in Transl. of Mr. Hodgson's Work*, p. 130.)

Subsequently to the period here referred to, Breschet has prosecuted this part of the inquiry, and ascertained, beyond all dispute, the reality of mixed aneurisms, and this in other arteries besides the aorta. Thus, his first example was a hernial protrusion of the inner coat of the popliteal artery, through the fibrous coat, and covered by the external tunic. (*Mém. sur l'Aneur.* p. 83.) His second case was a mixed aneurism, situated near the termination of the left iliac artery. (p. 93.)

By the term *mixed* aneurism, Dr. A. Monro, senior, implied the state of a true aneurism, when its cyst had burst, and the blood was diffused in the adjacent cellular substance; an event which is frequent. Besides these varieties of aneurism, the *aneurismal varix*, or *venous aneurism*, and the *aneurism by anastomosis*, constitute diseases which are usually regarded as cases pertaining to the present subject, though incapable of being comprised under the ordinary definition of an aneurism.

An aneurism may then be defined to be a tumour filled with blood, either in a fluid or solid state, usually attended with pulsation, and the sac of which has an opening in it, by which it communicates with the artery, from which the blood is transmitted into it. Lisfranc defines it, "a tumour formed by arterial blood, and communicating with an artery," and divides all aneurisms into *traumatic* and *spontaneous*, according as they happen to be produced by a wound, or disease of the coats of the artery. (*De l'Oblitération des Artères dans les Aneurismes*, p. 6.)

Nothing can be more manifest than the fact, that, previously to the discovery of the circulation of the blood, no correct, nor valuable opinions could have prevailed respecting the diseases which now go under the name of aneurisms. Indeed, it was not until after the days of Aristotle, that any distinction was made between the swellings of veins and those of arteries; such vessels not having been at that early period distinguished from each other. Their differences were first pointed out by Rufus of Ephesus. Down to Galen, however, nothing like consistency was established in the notions respecting aneurism. His opinion was, that all tumours of this nature were produced either by anastomosis, or by rupture; and though he has described their symptoms, he has not informed us of the characters by which each of these cases was distinguishable, one from the other. Paulus

Ægineta divides aneurism into two sorts, both of which, he says, are attended with extravasation, and of course with rupture. Vesalius, who first applied anatomy to the investigation of disease, described aneurism arising from the *rupture of* a *dilated* aorta; the first specimen, I believe, on record of this form of disease. (*Bonetus Sepulch. Anat.* lib. iv. sect. 2.)

The combination of rupture with dilatation of the artery, was afterwards more particularly noticed by Nuck (*Oper. Chir. &c.* Lugd. 1692); but it was Fernelius who first promulgated the doctrine, that aneurisms were always dilated arteries. (*Universa Medicina, De Extern. Corp. Affect.* lib. vii. cap. 3. Venet. 1564.)

This opinion was espoused by Forrestus, Diemerbroek, and others; but at length, the inaccuracy of attempting to refer every aneurism solely to dilatation of the coats of the vessel, was established by the observations of Lancisi, Freind, Guattani, and Morgagni. In short, as Mr. Hodgson has stated, these authors proved, that aneurism may be produced either by the rupture, or the dilatation of the coats of an artery, or by a combination of both circumstances, the dilatation having preceded the rupture. (*On the Dis. of Arteries, &c.* 8vo. Lond. 1815.)

In truth, this admission of aneurism by dilatation, and of aucurism by rupture of the coats of an artery, together with the frequent combination of both circumstances, became the prevailing undisturbed doctrine of every surgical school, until Professor Scarpa, inclining to the tenets of Sylvaticus (*De Aneurysmate, Tract.* Venetiis, 1600, 4to.), ventured to question the correctness of the common opinion about the dilatation of all the arterial coats. However, after the very clear and satisfactory elucidation of this disputed point by my friend Mr. Hodgson, and others, as well as by several preparations in the Hunterian collection (see *Guthrie on Dis. of Arteries*), the accurate views of the subject, first taken by Morgagni, and the other eminent writers specified above, may be regarded as established beyond the possibility of dispute. At the same time, it is not to be supposed that Scarpa means to say, that the arteries are not subject to a morbid dilatation; on the contrary, he gives a particular description of this affection, which he carefully descriminates from aneurism.

Previously to offering a more particular account of the doctrine taught by Scarpa, respecting the formation of aneurism, as well as of the chief facts, which may be adduced against a part of such doctrine, it seems proper to make the reader acquainted with the various forms of the disease, their ordinary symptoms, and a few pathological facts.

When any part of an artery is dilated (attended with particular circumstances marking its difference from another form of dilatation, which, as I shall explain, perhaps ought not to be set down as aneurismal), the swelling is commonly named a *true* or *genuine aneurism.* In such cases, the artery is either enlarged at only a small part of its track, and the tumour has a determinate border, or the vessel is dilated for a considerable length; in which circumstance the swelling is oblong, and loses itself so gradually in the surrounding parts, that its margin cannot be exactly ascertained. The first case, which is the most common, is termed the *circumscribed true aneurism;* the last, the *diffused true aneurism;* a case, however, which would be looked upon by Scarpa only as a specimen of dilatation, different in several particulars from aneurism, as will be hereafter noticed. When blood escapes from the wound or rupture of an artery, into the adjoining cellular substance, the opening in the skin having closed, the swelling is denominated a *spurious* or *false aneurism.* In this instance, the blood either collects in one mass, distends the cellular substance, and condenses it into a cyst, so as to form a distinctly circumscribed tumour; or it is injected into all the adjacent cellular substance, and extends along the course of the great vessels, from one end of the limb to the other, thus producing an irregular oblong swelling. The first case is named a *circumscribed false aneurism;* the second, a *diffused false aneurism.* (*Richter's Anfangsgr.* b. i.)

When an aneurismal sac is formed upon a dilated artery, the walls of the vessel are sometimes thinner than usual; and some parts of them may become expanded into pouches, or even engrafted upon the original swelling, the prominent points being always the thinnest. This kind of case is sometimes termed a *sacculated aneurism,* of which there is a good specimen in the Hunterian collection, remarkable also as exhibiting an aneurism opening by ulceration into the pulmonary artery. (See *Guthrie on Dis. of Arteries,* p. 59.)

Aneurism by dilatation is distinguished by Breschet into four varieties, the names of which are determined by the differences in the shape of the expansion of the arterial tube. For instance, 1. True *sacciform* aneurism: 2. True *fusiform* aneurism: 3. True *cylindroid* aneurism, subdivided into that of the large arteries, and into that of the small arteries, or the *aneurism by anastomosis* of John Bell, and the *erectile tumours* of Dupuytren: 4. True varix-like aneurism, or *aneurisma cyrsoideum.* In *sacciform* aneurism, the vessel has at one point of its circumference a small sac, consisting of an expansion of the arterial tunics. This variety is most frequent in the aorta, but sometimes on the carotid and iliac arteries, and even on those of the limbs. In this aneurism, all the arterial tunics are simultaneously dilated; but as the internal and middle ones have but a limited degree of extensibility, the sacciform aneurism does not generally exceed the size of a filbert, though Breschet has noticed some on the aorta as large as a hen's egg. (See *Breschet sur Différentes Espèces d'Aneurismes,* p. 12. &c.)

In the *true fusiform aneurism,* the dilatation extends over the whole circumference of the vessel: all the coats participate in it. The calibre of the artery, after becoming wider and wider gradually, for a certain portion of the track of the vessel, then lessens in a manner equally gradual, till it has resumed its natural diameter.

The *cylindroid* aneurism of Breschet might be regarded only as a variety of the fusiform, inasmuch as an abrupt transition from a given calibre to a much more capacious one is never observed. Yet, according to the investigations of Breschet, cases present themselves in which the artery is uniformly dilated through a track of one or two feet, the cylindrical form being here strictly preserved. This pathological fact has been noticed by Breschet in the arteries of the limbs, and in those of the brain, and of the splanchnic cavities. (*Op.* cit. p. 25.)

In the *true varix-like aneurism*, the artery is described by Breschet as being not only dilated, but tortuous, and occasionally studded with small sacciform tumours. The parietes of the vessel are thin and collapsed; while, in the other case, they are rather thickened. Such is Breschet's classification of true aneurism; a classification, which, embracing, as it does, aneurism by anastomosis and erectile tumours, and these of different kinds, presents a good deal of novelty.

The following are the symptoms of a circumscribed aneurism:—The first thing which the patient perceives, is an extraordinary throbbing in some particular situation, and, on paying a little more attention, he discovers there a small soft pulsating tumour, which in a great measure disappears when compressed, but returns again as soon as the pressure is removed. With the return of pulsation, and of the swelling, a peculiar thrilling feel is experienced, caused by the passage of the blood into the sac. If the artery be compressed on the distal side of the swelling, this will be rendered still larger and tenser. A spontaneous aneurism is generally slow in its growth, not perhaps exceeding the size of an egg in a year, and rarely that of a flattened orange. (*Guthrie, Op.* cit. p.108.) At first it is generally unattended with pain, or change in the colour of the skin. The pulsation is synchronous with the beat of the artery. When once the tumour has originated, it continually grows larger, though very gradually, and at length attains a considerable size. In proportion as it becomes larger, its pulsations become weaker; and, indeed, when the disease has acquired much magnitude, they are frequently either quite lost, or only distinguishable with the stethoscope. The diminution of the pulsation has been partly ascribed to the coats of the artery losing their dilatable and elastic quality, in proportion as they are distended, but chiefly to the lamellated coagulated blood deposited on the inner surface of the sac, particularly in large aneurisms, in which the motion of some of the blood is always interrupted. Immediately such coagulated blood lodges in the sac, pressure can only produce a partial disappearance of the swelling. This deposition of lamellated coagulum in the aneurismal sac is a circumstance of considerable importance; for it has been well explained by Mr. Hodgson, that it is the mode by which the spontaneous cure of the disease is in most instances effected. "One of the circumstances which, in the most early stage, generally attend the formation of aneurism, (says this author,) is the establishment of that process which is the basis of its future cure. The blood, which enters the sac soon after its formation, generally leaves upon its internal surface a stratum of coagulum, and successive depositions of the fibrous part of the blood gradually diminish the cavity of the tumour. At length, the sac becomes entirely filled with this substance, and the deposition of it generally continues in the artery, which supplies the disease, forming a firm plug of coagulum, which extends on both sides of the sac, to the next important ramifications that are given off from the artery. The circulation through the vessel is thus prevented, the blood is conveyed by collateral channels, and another process is instituted, whereby the bulk of the tumour is removed," &c. (*On the Diseases of Arteries, &c.* p. 114.) Whether there is any truth in Kreysig's conjecture, that some of the lymph may exude from the inside of the sac itself, I cannot presume to say; he owns, however, that the inner concentric layers presenting the appearance of being deposited last, is a circumstance rather against his surmise, though he adverts to some other circumstances which incline him to look upon the opinion as possibly correct. (*German Transl. of Mr. Hodgson's Work*, p. 124.)

When the aneurism has not been caused by dilatation, but by a rupture of the inner coats of the vessel, the patient usually refers to some particular period, and generally to one of exertion, when this rupture was indicated by pain of a more or less acute nature, which either continued with a corresponding degree of lameness, or left such a sense of uneasiness as made the patient put his hand frequently on the part. On one of these occasions, the pulsating tumour is discovered. If the aneurism, whether of one kind or another, be in the ham, the patient first limps; then the leg becomes permanently bent; and when the tumour begins to press on the nerves, veins, and absorbents, the toes and leg are extremely painful, and the foot and leg œdematous. (See *Guthrie on Dis. of Arteries*, p. 109.)

It is the general belief, that the pulsation of the tumour is produced by the jet of blood into it at each stroke of the heart. This opinion, however, is disputed by an eminent writer, who asks, Is it true, that the pulsation of aneurisms proceeds from the entrance of a more considerable stream of blood into the sac, and the distension of the swelling thereby produced? In aneurisms, which have only a narrow communication with the arterial tube, or which are filled with laminated coagula, the idea, says he, is quite inadmissible: the aneurism is rather shaken, as it were, like other different swellings in the vicinity of an artery, by the stroke of the heart occasioning a stretching of the whole arterial system, and at the same time communicating an impulse to the column of blood. (*Kreysig, Germ. Tr. of Mr. Hodgson's Work*, p. 143.) Here, I am by no means disposed to coincide with this distinguished physician, whose sentiments appear to me to be refuted by the fact, that, whenever any change happens, calculated to lessen, or entirely stop the influx of blood into the sac, the pulsation either diminishes, or ceases in proportion. Thus, when Kreysig adverted to the pulsation of aneurisms, in which much coagulated blood was deposited, he might at the same time have mentioned the effect which such deposition has in weakening the pulsation, the layers of coagulated blood, within the tumour, being in the natural mode of cure, "the means by which the force of the circulation is removed from the sac, and the fatal termination of the disease by rupture is prevented." (See *Hodgson on Diseases of the Art. and Veins*, p. 126.) In proportion as the aneurismal sac grows larger, the passage of blood into the artery beyond the tumour is lessened. Hence, in this state, the pulse, below the swelling, becomes weak and small, and the limb frequently cold and œdematous. On dissection, the lower continuation of the artery is found preternaturally small and contracted. The pressure of the tumour on the adjacent parts may also produce a variety of symptoms, — ulceration, absorption of bone, &c. Sometimes (says Richter) an accidental contusion, or concussion, may detach a piece of coagulum from the inner surface of the cyst, and the circulation through the sac be obstructed by it: nay, he asserts, that the coagulum may possibly be impelled quite into the artery below, so as to induce important changes. The danger of an aneurism arrives when it is on the point of bursting, by which occurrence the patient usually bleeds to death, and this sometimes in a few seconds. In an external aneurism, the fatal event may generally be foreseen, as the part about to give way becomes particularly tense, elevated, thin, soft, and of a dark purple colour. (See *Richter's Anfangsgr.* band i.)

A large axillary aneurism, which I saw burst in St. Bartholomew's Hospital some years ago, did not burst by ulceration, but by the detachment of a small slough from a conical, discoloured part of the tumour, followed at first by an oozing of blood, and at length by one copious and fatal discharge of it; and soon after this case fell under my observation, I had an opportunity of seeing the process, by which an inguinal aneurism burst: at a certain point, the tumour became more conical, thin, and inflamed, and here a slough, about an inch in width, was formed. On the dead part becoming loose, a profuse bleeding began, which was stopped for a short time by pressure, but soon returned with increasing violence, and put an end to the patient's misery. We are then to conclude, that external aneurisms do not burst by ulceration, but, by the formation and detachment of a slough. I believe this is a fact, which was first particularly pointed out in the early editions of my work; and it gives me pleasure to find, that it is a statement which entirely coincides with that subsequently made by several writers of eminence, especially Mr. A. Burns (*On Diseases of the Heart*, p. 225.), and Boyer (*Traité des Maladies Chirurgicales*, t. ii. p. 98.)

As far as my information extends, Mr. A. Burns first explained the very different mode of rupture which happens in internal aneurisms: these, he observed, generally burst by actual laceration, and not by sphacelation of the cyst. (*On Diseases of the Heart*, p. 225.) But a still more particular account of the process, by which external and internal aneurisms burst, is delivered by Mr. Hodgson. When the sac points externally (says this gentleman), it rarely or never bursts by laceration, but the extreme distention causes the integuments and investing parts to slough; and upon the separation of the eschar, the blood issues from the tumour. A similar process takes place, when the disease extends into a cavity, which is lined by a mucous membrane, as the œsophagus, intestines, bladder, &c. In such cases, the cavity of the aneurism is generally exposed by the separation of a slough, which has formed upon its most distended part, and not by laceration. But, when the sac projects into a cavity lined by a serous membrane, as the pleura, the peritoneum, the pericardium, &c., sloughing of these membranes does not take place; but the parietes of the tumour having become extremely thin in consequence of distention, at length burst by a crack, or fissure, through which the blood is discharged. (*On the Diseases of Arteries, &c.* p. 85.) An aneurism, however, which burst into the œsophagus, and which I had an opportunity of examining after the patient's death, was found to have done so by an ulcerative process. The mucous membrane of the trachea is also sometimes perforated by ulceration, the commencement of which is delineated in Cruveilhier's plates. (See *Anat. Pathol.* livr. iii. pl. 3. et 4.)

When the aneurism is of considerable size, the collateral arteries, which originate above the swelling, are manifestly enlarged. Boyer informs us, that, in dissecting the lower extremity of a patient, on whom Desault had operated eight months previously for a popliteal aneurism, he found in the substance of the great sciatic nerve an artery, whose diameter was equal to that of the radial at the wrist. This vessel had its origin from the ischiatic artery, and descended to the back part of the knee, where it anastomosed with the upper articular arteries. Boyer had also noticed in the same subject before the operation, that one of the branches of the upper internal articular artery was so much enlarged, that its pulsation could be plainly felt on the internal condyle of the thigh-bone. (*Op* cit. p. 93.) It is such enlargement of the collateral arteries above the disease, which ensures to the limb below the tumour an adequate supply of blood when the obstruction to its passage through the diseased artery becomes considerable, or when this vessel has been rendered totally impervious by a surgical operation performed for the cure of the complaint.

In the advanced stage of an aneurism, the skin is found extremely thin, and confounded, as it were, with the aneurismal sac. The cavities of the cellular substance near the disease are either filled with serum, or totally obliterated by adhesion. The adjacent muscles, whether they lie over the aneurism, or to one side of it, are stretched, displaced, dwindled, and sometimes confounded with other parts. It is the same with the large nervous cords situated at the circumference of the tumour: they are pushed out of their natural situation, diminished in size, sometimes adherent to the outside of the sac, and so changed as scarcely to admit of being known again. Lastly, the cartilages and the bones themselves are not exempt from the mischief, which the aneurismal swelling produces in all the surrounding parts: they are gradually destroyed, and, at length, not the least trace of their substance remains, just in the same way as the bones of the cranium are destroyed by fungous tumours of the dura mater. (See Dura Mater.) Even the cartilages of the larynx, and rings of the trachea, are sometimes destroyed; this tube is pierced, and the blood escapes into it, or the aneurism bursts into the œsophagus. (*Boyer, Traité des Maladies Chir.* t. ii. p. 99.; *S. Cooper, Med. Chir. Trans.* vol. xvi. p. 399., &c.) As I shall hereafter explain, however, the pressure of an aneurismal tumour more quickly produces an absorption of bone, than of cartilage. Aneurism of the arch of the aorta, or of the subclavian artery (*Guthrie on Diseases of Arteries*, p. 63.), sometimes occasions a dislocation of the sternal end of the clavicle.

While an aneurism is small and recent, it does not generally cause much pain, nor seriously impede the functions of the limb. But when it has increased, several complications are produced. Thus, the dragging of the great saphenal nerve, by femoral aneurisms, frequently occasions acute pain in the course of this nerve as far as the great toe. The distention of the sciatic nerve by the popliteal aneurism, sometimes brings on intolerable pain, which extends to all the parts to which the nerve is distributed, and which can hardly ever be appeased by the topical use of opiate applications. The compression of the veins and lymphatics give rise to œdema, numbness, and coldness of the limb. And, finally, the long-continued pressure of the aneurism on the neighbouring bones causes their destruction. (*Boyer*, t. ii. p. 105.)

In true aneurism, the coats of the artery are not always in the same state, the kind of changes observed depending upon the progress of the tumour. In the early stage of the disease, either the whole cylinder of the vessel, or only a part of its circumference, is dilated; but this period is generally of short duration, especially in arteries of middling size, because their middle coat is capable of less resistance than that of the larger arteries, like the aorta, where this coat is yellowish, firm, and very elastic. As Breschet remarks, this difference of resistance in the middle coat of the aorta, and the branches given off from it, accounts for the rarity of true aneurisms either in the small arteries, or those of middling size, and their greater frequency in the principal trunk of the arterial system.

At length, in consequence of the increasing distention, some of the coats of the artery possessing the least elasticity give way; and these are found to be the internal and middle coats; while the external one still makes resistance, and continues to be more and more dilated by the lateral impulse of the blood.

The second stage of true aneurism is that in which the surgeon is usually consulted; that in which the tumour increases more rapidly and therefore begins to excite greater attention. The disease has now made its way through the internal and middle coats of the artery, and the external coat yields with more facility. In this stage, if the artery be only covered by a serous membrane, which soon gives way, the patient's life is endangered, and death often brought on by the rupture of the tumour. Examinations of the dead subject under these circumstances, have frequently led to mistaken notions; and, doubtless, if various swellings of this kind had not been found in different degrees, or stages, in the same individual, one might have been disposed to join Scarpa in the belief, that no aneurism consists of a dilatation of all the arterial coats. (*Breschet, Fr. Transl. of Mr. Hodgson's Work*, p. 128, 129.)

The change of an aneurism from the circumscribed into the diffused state is indicated by a sudden reduction, or stoppage of the pulsations of the tumour, often preceded by a sensation of something breaking, or giving way in the limb, which becomes all at once very painful. The temperature of the foot suddenly falls; and the swelling undergoes a rapid increase, and also becomes more diffused. The two latter circumstances may indeed not be very obvious, when the limb is already very œdematous, or the aneurismal sac has given way in a deep situation, and the blood has escaped into the cellular tissue between the muscles and under the fascia. In these cases, however, there is always some point of the leg or foot marked by a livid discolouration; and as the distention of the cellular tissue with blood, and the augmented interruption of the circulation in the limb, bring on a tendency to gangrene, the patient's pulse becomes accelerated. Here the danger of mortification is much greater than when the sac bursts, and the blood, instead of passing extensively into the cellular tissue, accumulates in one mass. Mr. Lawrence communicated to the Med.Chir. Society an instance in which the mass of blood collected in the thigh was so enormous after the giving way of a femoral aneurism under the skin, that, when the coagula were removed, by means of a free incision, some time after the artery had been tied, the finger could be passed nearly all round the thigh-bone. But, nothwithstanding this mass of blood, and profuse suppuration, the patient recovered. (See *Med. Chir. Trans.* vol. xvi. p. 321.)

When the sac of an aneurism has burst in the foregoing manner, the propulsion of blood into it from the heart can evidently no longer have the effect of producing a full and sudden distention of it, as more or less of that fluid will either escape from it into the cellular membrane, or collect in one mass out of the aneurismal cavity. In general, however, the pulsations are only weakened at first and several days elapse before they entirely cease. Another cause that has a powerful effect in putting an end to the pulsations, is the increase in the quantity of coagulated blood and fibrine in the sac; the inevitable result of the stream of blood through it becoming more and more retarded, in proportion as the obstruction of the circulation in the leg augments. In cases of doubt, whether the reduction and stoppage of the pulsation are owing to the circumstances here adverted to, or to the sac having becomed filled with lamellated blood without any rupture of it, and change of the aneurism from the circumscribed to the diffused state (a condition promising the accomplishment of a complete cure), the stethoscope should be employed, whereby, in the former case, the sound of the jet of blood into the sac, the bellows-sound, as it is termed, will be perceived. This symptom, with others to which I have adverted, would render the state of things sufficiently clear. (See *Med. Chir. Trans.* vol. xvi. p. 320. &c.)

A *false aneurism* is always attended with at least a rupture, or giving way of the inner coat of the vessel, and usually with a breach in both this and the muscular coat, the outer elastic tunic forming the pouch in which the blood collects. But, after the swelling has attained a certain size, this coat also bursts, and then the blood either becomes diffused, or a large circumscribed space is formed for it by the condensation of the surrounding cellular membrane. False aneurisms, when produced by a wound, or puncture, are of course from the first attended with a division of all the coats of the vessel. This form of the disease is often seen at the bend of the arm, where the artery is exposed to injury in venesection. (See HEMORRHAGE.) In this circumstance, as soon as the puncture is made, the blood gushes out with unusual force, and in a bright scarlet, irregular, interrupted current; flowing out, however, in an even, and less rapid stream, when pressure is applied higher up than the wound. These last are the most decisive marks of the artery being opened; for blood may issue from a vein with great rapidity, and in a broken current, when the vessel is turgid, and situated immediately over the artery, which imparts its motion to it. The surgeon endeavours precipitately to stop the hemorrhage by pressure, and in general a *diffused false aneurism* is the result. The external wound in the skin is closed, so that the blood cannot escape; but, this does not hinder it from passing into the cellular substance. The swelling, thus produced, is uneven, often knotty, and extends upward and downward along the track of the vessel. The pulsation is more feeble than that of a true aneurism, and is sooner lost. The skin is also usually of a dark purple colour. The swelling increases, as long as the internal hemorrhage continues; and if this should proceed beyond certain bounds, mortification of the limb ensues. Such is the *diffused false aneurism* from a wound; a case which Lisfranc regards only as an extravasation of arterial blood, and reluctantly classes with aneurism at all. (*De l'Oblitération des Artères dans le Traitement des Aneurismes*, p.6.)

The *circumscribed false aneurism*, from a wound or puncture, arises in the following manner. When proper pressure has been made in the first instance, so as to suppress the hemorrhage, but the bandage has afterwards been removed too soon, or before the artery has healed, the blood passes through the unclosed wound, or that which it has burst open again, into the cellular substance. As this has now become agglutinated by the preceding pressure, the blood cannot diffuse itself into its cells, and, consequently, a mass of it collects in the vicinity of the aperture of the artery, and distends the cellular substance in the form of a sac. Sometimes, though not often, the circumscribed false aneurism originates immediately after the opening is made in the artery. This chiefly happens when the aperture in the vessel is exceedingly small, and, consequently, when the hemorrhage takes place so slowly that the blood, which is first effused, coagulates, and prevents the entrance of that which follows into the cavities of the cellular substance, and, of course, its diffusion. A traumatic false aneurism differs materially from one which has taken place spontaneously, or as a consequence of disease; for, in the former, the artery is generally unsound for some distance above and below the tumour. In the aneurism from a wound, the artery is perfectly sound, except inasmuch as the injury is concerned, and no effort is yet made by nature to obliterate the artery below or beyond the aneurism, which frequently takes place, when an aneurism occurs from disease. There are also other important differences in relation to the collateral circulation, and the requisite surgical operation. (See *Guthrie on the Diseases of Arteries*, p. 82.)

In aneurism, the separation of the external from the middle coat of an artery is generally effected with difficulty; the external coat becomes stretched and distended, and an aneurismal tumour is formed. To this, however, there are a few uncommon exceptions; for the blood may be forced along the artery, separating the external and middle coats from each other, and forming a pouch several inches in length, which may or may not completely surround the vessel. In one case, reported by Mr. Guthrie, it formed a pouch on the anterior part of the descending aorta, about six inches in length, extending to the sides, and in one place nearly surrounding it. A horizontal fissure, about half an inch in extent, near the upper part of the swelling, allowed the blood to pass through the inner and middle coats, and to effect this separation, *which*, as Mr. Guthrie observes, *could only have arisen from disease previously existing in the part.* (See *Guthrie on Dis. of Arteries*, p.40.) Laennec gave an account of a very similar, but of a more extensive case of this kind, in a person who was not suspected during life to have disease of the heart or arteries. (*De l'Auscult.* t. ii. p. 700.) Mr. Guthrie also met with a third example, which is the preparation No. 368 A. in the Museum of the College of Surgeons. Just below the point where the innominata is given off, the inner and middle coats are ruptured along half the circle of the aorta, as cleanly as if cut with a knife. The effused blood has separated the outer from the fibrous coat down to the origin of the aorta. The separation is also continued along the descending aorta for an inch beyond the left subclavian, and the interval filled with blood. The arteria innominata had in the front half of it another transverse rent in all its coats, where the hemorrhage took place which killed the patient. The descending portion of the aorta, and the roots of the great vessels, are covered with atheromatous patches, and in part with bony scales. The coats were all easily separable, and softer and more readily broken than natural. (*Guthrie, Op.* cit. p. 43.)

Cases of the foregoing description are sometimes termed *dissecting aneurisms*, of which the late Mr. Shekelton described one modification, not previously noticed by any other pathologist, and the peculiarity of which was, that after the blood had forced its way through the inner and middle coats of the vessel, it not only detached the middle from the outer coat to the extent of four inches, but then forced its way into the canal of the artery again, through the middle and inner coats: thus two channels existed for the passage of the blood. In the end, the formation of the new passage led to the obliteration of the original one, or corresponding portion of the arterial tube. (See *Dublin Hospital Reports*, vol. iii.)

Formation of Aneurisms.

If the doctrines of Scarpa, published in 1804, had proved correct, the grand distinction of aneurism into *true* and *false* must have been rejected as erroneous: "for," says he, "after a very considerable number of investigations, instituted on the bodies of those who have died of internal or external aneurisms, I have ascertained, in the most certain and unequivocal manner, that there is only one kind or form of this disease, viz. that caused by a solution of continuity, or rupture of the proper coats of the artery, with effusion of blood into the surrounding cellular substance; which solution of continuity is occasioned sometimes by a wound, a steatomatous, earthy degeneration, a corroding ulcer, or a rupture of the proper coats of the artery, I mean the internal and muscular, without the concurrence of a preternatural dilatation of these coats being essential to the formation of this disease; and, therefore, that every aneurism, whether it be internal or external, circumscribed or diffused, is always formed by effusion." (*On Aneurism*; transl. by Wishart, Pref.)

According to Scarpa, it is an error to suppose, that the aneurism at the curvature or in the trunk of the aorta, produced by a violent and sudden exertion of the whole body, or of the heart in particular, and preceded by a congenital relaxation of a certain portion of this artery, or a morbid weakness of its coats, ought always to be considered as a tumour formed by the distention or dilatation of the proper coats of the artery itself, that is, of its internal and fibrous coats. Scarpa considers it quite demonstrable, that such aneurisms are produced by a corrosion and rupture of these tunics, and, consequently, by the effusion of arterial blood under the cellular sheath, or other membrane, covering the vessel. If ever there be a certain degree of preceding dilatation, it is not essential to constitute the disease, for it is not a constant occurrence; most aneurisms are unpreceded by it, and, in those rare cases in which an aneurism is preceded and accompanied by a certain degree of dilatation of the whole diameter of the curvature of the aorta, there is an evident difference between an artery simply enlarged in diameter, and the pouch which forms an aneurismal sac.

Careful dissections, says Scarpa, will prove that the aorta contributes nothing to the formation of the aneurismal sac, and that this is merely the cellular membrane, which, in the sound state, covered the artery, or that soft cellular sheath which the artery received in common with the neighbouring parts. This is raised by the blood into the form of a tumour, and is covered, in common with the artery, by a smooth membrane.

This eminent professor does not deny that, from congenital relaxation, the proper coats of the aorta may occasionally yield and become disposed to rupture; but he will not admit that dilatation of this artery precedes and accompanies all its aneurisms, or that its proper coats ever yield so much to distention as to form the aneurismal sac. *The root of an aneurism of the aorta never includes the whole circumference of the artery;* but the aneurismal sac arises from one side of it in the form of an appendix, or tuberosity. On the contrary, the *dilatation of the artery always extends to its whole circumference,* and, therefore, differs essentially from aneurism. Thus he urges, that there is a remarkable difference between a dilated and an aneurismal artery, although *these two affections are sometimes found combined together,* especially at the origin of the aorta. If we also consider, that the dilatation of an artery may exist without any organic affection, the blood being always in the cavity of the vessel; that, in an artery so affected, there is never collected any grumous blood, or polypous layers; that the dilatation never forms a tumour of considerable bulk; and that, while the continuity of the proper coats remains uninterrupted, the circulation of the blood is not at all, or not so sensibly changed, we shall be obliged to allow, that aneurism differs essentially from one kind of dilatation of an artery.

Some additional remarks on this topic, more recently published by Scarpa, will be presently considered.

By dissections of arteries, both in the sound and morbid state, Scarpa endeavours to demonstrate what share the proper and constituent coats of the artery have in the formation of the aneurismal sac, and what belongs to the cellular covering, and other adventitious membranes surrounding the artery.

The covering of an artery is merely an adventitious sheath, which the vessel receives in common with the parts in the vicinity of which it runs. On cutting an artery across in its natural situation, the segment of the cut vessel retires and conceals itself in this sheath.

This cellular covering is most evident round the curvature and trunk of the aorta, the carotid, mesenteric, and renal arteries; it is less dense round the trunks of the brachial, femoral, and popliteal arteries. The plura lies over the cellular sheath of the arch of the aorta, and over that of the thoracic aorta; while that of the abdominal aorta is covered by the peritoneum. Both these smooth membranes adhere to, and surround, two thirds of the circumference of the vessel. The great arteries of the extremites are not covered, in addition to the cellular substance, by any smooth membrane of this sort, but by a cellular sheath, which is demonstrably distinct from the adipous membrane, and serves to enclose the vessels, and connect them with the contiguous parts.

When air, or any other fluid, is injected by a small hole, made artificially between the cellular covering and the subjacent muscular coat of the artery, the injected matter elevates into a tumour the cellular membrane, which closely embraces the artery, without properly destroying its cells, which it distends in a remarkable manner. When melted wax is injected, and pushed with much force, the cellular sheath of the artery is not only raised over the vessel, like a tumour, but the internal cells of that covering are also lacerated; and, on examining afterwards the capsule of the artificial tumour, it appears as if it were formed of several layers, rough and irregular internally, smooth and polished externally. The same thing happens when any injection is pushed with such force into an artery as to rupture the internal and muscular coats at some point of their circumference. Nicholls performed this experiment several times before the Royal Society. (*Philos. Trans.* an. 1728.) As soon as the internal coat is ruptured, the muscular one also gives way; but the external cellular sheath, being of an interlaced texture, and the thin laminæ of which it is composed being not simply applied to one another, but reciprocally intermixed, is capable of supporting great distention, by yielding gradually to the impulse of the blood, without being torn or ruptured.

Scarpa is farther of opinion, that the same phenomena may be observed, when the internal coat of the aorta becomes so diseased as to be ruptured by the repeated jets of blood from the heart. In this circumstance, the blood, impelled by the heart, begins immediately to ooze through the connections of the fibres of the muscular coat, and gradually to be infused into the interstices of the cellular covering, forming, for a certain extent, a kind of *ecchymosis,* or *extravasation of blood,* slightly elevated upon the artery. Afterwards, the points of contact between the edges of the fibres of the muscular coat, being insensibly separated, the arterial blood, penetrating between them, fills the cellular covering of the artery, and raises it after the manner of an incipient tumour. Thus, the fibres and layers of the muscular coat, being wasted, or lacerated, or simply separated from each other, the arterial blood is carried with great force, and in greater quantity than before, into the cellular sheath of the artery, which it forces more outwards; and, finally, the divisions between the interstices of the cellular coat, being ruptured, it is converted into a sac, which is filled with polypous concretions and fluid blood, and at last forms, strictly speaking, the aneurismal sac. The internal texture, although apparently composed of membranes placed one over the other, is, in fact, very different from that of the proper coats of the artery, notwithstanding the injured vessel and aneurismal sac are both covered externally in the thorax and abdomen with a smooth membrane.

Scarpa has examined a considerable number of aneurisms of the arch, and of the thoracic and abdominal trunks of the aorta, without finding a single one in which the rupture of the proper coats of the artery was not evident, and in which, consequently, the sac was produced by a substance completely different from the internal and muscular coats.

The aneurismal sac never comprehends the whole circumference of the vessel. At the place where the tumour joins the side of the tube, the aneurismal sac presents a kind of constriction, beyond which it becomes more or less expanded. This would never happen, or rather the contrary circumstance would occur, if the sac were formed by an equable distention of the tube and proper coats of the affected artery. In incipient aneurisms, at least, the greatest size of the tumour would then be in the artery itself, or root of the swelling, while its fundus would be the least. But, *whether aneurisms be recent and small, or of long standing and large, the passage from the artery is always narrow, and the fundus of the swelling greater in proportion to its distance from the vessel.* The sac is always covered by the same soft dilatable cellular substance which united the artery in a sound state to the circumjacent parts. Such cellular substance, in aneurisms of the thoracic aorta, is covered by the pleura, and, in those of the abdominal aorta, by the peritoneum, which membranes include the sac and ruptured artery, presenting outwardly a continued smooth surface, just as if the artery itself were dilated. But, if the aorta be opened lengthwise on the side opposite the constriction, or neck of the tumour, the place of the ulceration, or rupture, of the proper coats of the artery, immediately appears within the vessel, on the side opposite to that of the incision. The edge of the fissure, which has taken place, is sometimes fringed, often callous and hard, and through it the blood formed for itself a passage into the cellular sheath, which is converted into the aneurismal sac. If, as sometimes happens, in the arch of the aorta near the heart, the artery, before being ruptured, has been somewhat dilated, it seems, at first, as if there were two aneurisms; but, the constriction, which the sac next to the artery presents externally, points out exactly the limits, beyond which the internal and muscular coats of the aorta had not been able to resist the distention, and where of course they have been ruptured. The partition, which may always be seen dividing the tube of the artery from the aneurismal sac, and which is lacerated in its middle, consists of nothing else than the remains of the internal and muscular coats of the ruptured artery.

By carefully dissecting the proper coats of the ruptured aorta in its situation, and comparing them with the cellular substance forming the sac, Scarpa affirms, that the truth of the preceding statement may be indisputably demonstrated.

When an incision is made lengthwise in the side of the vessel opposite the rupture, its proper coats are found either perfectly sound, or a little weakened and studded with earthy points, but still capable of being separated into distinct layers. On the contrary, in the opposite side of the aorta, where the rupture is, the proper coats are unusually thin, and are only separable from each other with difficulty, or even not at all; they are frequently brittle like an egg-shell, and are disorganized and torn at the place where they form the partition between the ruptured artery and the mouth of the aneurismal sac. Continuing to separate these coats from within outwards, we arrive at the cellular sheath surrounding the aorta. This sheath being much thickened in large aneurisms, and adherent to the subjacent muscular coat of the artery at the place of the constriction of the sac, is likely to be mistaken for a dilated portion of the vessel itself. But, even in such cases, we may at last separate it, without laceration, from the tube of the artery, above and below the injury, and, successively, from the muscular coat, as far as the neck of the aneurism. Then, it is clear, the muscular coat does not pass beyond the partition, separating the cavity of the artery from that of the aneurismal sac, over which it is not prolonged, but terminates at the edge of the rupture like a fringe, or in obtuse points. Errors seem to Scarpa more apt to occur, in consequence of the aorta and sac being both covered by the pleura or peritoneum.

The portion of the aorta within the pericardium being only covered by a thin reflected layer of this membrane, such layer may also be lacerated, when the proper coats give way, and blood be effused into the cavity of the pericardium. Examples of this kind are related by Walter, Morgagni, and Scarpa himself. In the latter instance, on making an incision into the concave part of the aorta, opposite the tumour which had formed under the layer of the pericardium, which had also burst, by a small aperture, its internal coat, corresponding to the base of the swelling, was quite rough, interspersed with yellow hard spots, and actually ulcerated for the space of an inch in circumference. The preparation is preserved in the Museum at Pavia.

But, all other parts of the aorta having, between them and the pleura and peritoneum, a cellular sheath of a stronger and more yielding nature, which allows itself to be distended into a sac, and being strengthened, internally, by polypous layers, and, externally, by the pleura or peritoneum, oppose for a long while the fatal effusion of blood.

Scarpa believes, that what he calls the chronic steatomatous, squamous degeneration of the artery, is more frequently the cause of its bursting than violent exertions of the whole body, blows, or an increased impulse of the heart. This kind of diseased change is very common in the curvature, and in the thoracic and abdominal trunks of the aorta. In the incipient state of such disease, the internal coat of the artery loses, for a certain space, its beautiful smoothness, and becomes irregular and wrinkled. It afterwards appears interspersed with yellow spots, which are converted into grains, or earthy scales, or into steatomatous and cheese-like concretions, which render the internal coat of the artery brittle, and so slightly united to the adjoining muscular coat, that, upon being merely scratched with the knife, or point of the nail, pieces are readily detached from it, and, on being cut, it gives a crackling sound, similar to the breaking of an egg-shell. This ossification cannot be said to be proper to old age, since it is sometimes met with in subjects not much advanced in life. The whole of the side of the artery, in that portion which is occupied by the morbid affection, is, for the most part, hard and rigid, sometimes soft and fungous; and, in most cases, the canal of the artery is preternaturally constricted. In the highest degree of this morbid disorganization, true ulcerations are found on the inside of the artery, with hard and fringed edges, fissures, and lacerations of the internal and fibrous coats of the artery.

Having presented the reader with an abridged account of the most important remarks made by Scarpa, in support of the doctrine he defends, I now annex his conclusions. 1. That aneurism is invariably formed by the rupture of the proper coats of the artery. 2. That the aneurismal sac is never formed by a dilatation of the proper coats of the artery, but, undoubtedly, by the cellular sheath, which the artery receives in common with the parts contiguous to it; over which cellular sheath the pleura is placed in the thorax, and the peritoneum in the abdomen. 3. That if the aorta, immediately above the heart, appears sometimes increased beyond its natural diameter, this is not common to all the rest of the artery; and when the aorta, in the vicinity of the heart, yields to a dilatation greater than natural, this dilatation does not constitute, properly speaking, the essence of the aneurism. 4. That there are none of those marks regarded by medical men as characteristic of aneurism from *dilatation*, which may not be met with in aneurism from *rupture*, including even the circumscribed figure of the tumour. 5. That the distinction of aneurism into *true* and *spurious*, adopted in the schools, is only the production of a false theory; since observation shows, that there is only one form of the disease, or that caused by a rupture of the proper coats of the artery, and an effusion of arterial blood into the cellular sheath, which surounds the ruptured artery.

Such were the inferences made by Scarpa, in 1804, one of the most distinguished anatomists and surgeons of his time. Great as his authority was, several eminent modern surgeons, as Richerand, Boyer, Dubois, Dupuytren, Sabatier, Breschet, &c. did not yield to it, but still contended that, in some aneurisms, the coats of the artery were dilated. These professors in France coincided with what has been usually taught upon this subject in the surgical schools of Great Britain. Every lecturer here has been accustomed to describe the distinctions of aneurisms into true and false, or into some cases which are accompanied with dilatation, and into others which are attended with rupture of the arterial coats. Many years ago, Mr. Hodgson, of Birmingham, published a valuable treatise, in which he differs from Scarpa, and joins those surgical writers who believe in the occasional dilatation of the coats of the arteries in this disease. He enquires, "Is every aneurism produced by a destruction of the internal and middle coats of the vessel? and does not a partial dilatation of these coats occasionally precede, and give rise to, their destruction? I believe that this is frequently the case. We have seen, that the disorganization of the coats of an artery, by destroying their natural elasticity, will give rise to permanent dilatation of the whole circumference of the vessel; and there is every reason to expect, that a loss of its elasticity in a portion only of the diameter of the vessel, will give rise to a partial dilatation of its coats. Indeed, the proofs of a partial dilatation of the coats of an artery, particularly of the aorta, are incontestably established by the possibility of tracing the coats of the vessel, throughout the whole extent of the expansion, and by the existence of those morbid appearances in the sac which are peculiar to the coats of the arteries.

"In the year 1811 (says Mr. Hodgson), I dissected an aneurism of the aorta, which was removed from the body of a young woman, by my friend Dr. Farre. The sac was as large as a small melon, and had proved fatal by bursting into the posterior mediastinum, and subsequently into the cavity of the thorax. This aorta exhibited the formation of aneurism by partial dilatation in three distinct stages. The internal coat was throughout inflamed, and presented a fleshy and irregular appearance. At the arch of the aorta, there was a dilatation not larger than the half of a small pea. About two inches lower in the same vessel was a second dilatation, which would have contained a hazel nut; and immediately above the diaphragm was the large aneurism which had proved fatal. I removed that portion of the vessel which contained the smallest dilatation, and macerated it until its coats could be separated without violence. I found that the dilatation existed equally in the three coats of the vessel, and, when separated, each presented the appearance of a minute aneurism. The second dilatation exhibited the same circumstances in a more advanced stage. The coats of the vessels were more intimately adherent to each other than in a natural state, but, it was evident that the dilatation consisted in a dilatation of the internal, the middle, and the external coats of the aorta. In the large anuerism, the disorganized internal and middle coats could be traced for some distance into the sac, when the parts contained in the posterior mediastinum, and the vertebræ, formed the remainder of the cyst. There can be little doubt that this sac commenced in a dilatation of the coats of the vessel, similar to those appearances which existed in the superior portion of the dissection, and the artery appeared to illustrate the formation of aneurism by partial dilatation in three distinct stages." (*Hodgson on the Diseases of Arteries and Veins*, p. 66. 68. See also *G. Andral, Précis d'Anat. Pathol.* t. ii. p. 361.) So far as Kreysig's information extends, nobody before Mr. Hodgson had examined the structure of an aneurismal sac in this accurate manner, viz. by maceration, and the results, he thinks, are not liable to the slightest objections. (See the *German Transl. of Mr. Hodgson's Work, with Notes by Kreysig and Koberwein*, p. 109. Hanover, 1817.)

Mr. Hodgson has seen this partial dilatation in almost all the arteries which are subject to aneurism, at the divisions of the carotids and iliacs, in the arteries of the brain, &c.; and he agrees with Dr. Baillie (*Morbid Anatomy, &c.*), Laennec (*Cerattius, Beschreib. d. Krankh. Preparate d. Anat. Theatres zu Leipz.* p. 408. 8vo. 1819), and others, that aneurisms, at the origin of the aorta, are generally formed by dilatation of the coats of the vessel.

"Partial as well as general dilatation (says Mr. Hodgson) frequently precedes the formation of aneurism in the arteries of the extremities. A gentleman had a large aneurism in the thigh, which had undergone a spontaneous cure. Upon examining the limb after death, the popliteal artery was found to be thickened and covered with calcareous matter. A small pouch, which would have contained the seed of an orange, originated from the side of this artery. This little sac was evidently formed by a dilatation of the coats of the vessel. A man died from the sloughing of an aneurism in the ham; in the femoral artery there was a small aneurism, about as large as a walnut. The external coat was disssected from the surface of the tumour to a considerable extent. The internal and middle coats were evidently dilated, and contributed to the formation of the sac. The dilatation of these coats was gradual, and they continued for a considerable distance to form the sac, when they were inseparably blended with the surrounding parts." (*Op.* cit. p. 70.) In one particularly interesting case of popliteal aneurism recorded by Breschet, where the internal coat, and in part also the fibrous, could be traced over the swelling, there was likewise an aortic aneurism, extending from the heart to four inches above the bifurcation of the aorta, where the swelling ended in an abrupt and circular manner. The middle and external tunics were perfectly healthy; and the internal, with the cellular tissue around it, alone diseased. In fact, when the lining of the artery was removed at the points where any morbid alterations were seen, these were also taken away, and the fibrous tunic left unchanged. In the limb, indeed, where the popliteal aneurism existed, all the arteries were aneurismal, and afforded most convincing evidence of all their coats contributing to the dilatations. (See *Breschet, Mém. Chir. sur différentes Espèces d'Aneurysmes*, p. 40., &c.)

While Mr. A. Burns bears testimony to the fidelity and accuracy of Scarpa's general detail, he adds, that perhaps it may not be uniformly found, that "the root of an aneurism never includes the whole circumference of the tube of an artery." We have, says he, a preparation in which the reverse has taken place. In this case, the whole cylinder of the vessel, from the heart to beyond the curvature, is equally dilated; and dilated to such an extent, that the tumour measures no less than ten inches in circumference. Scarpa limits dilatation, says Mr. Burns, to that state of an artery in which the coats remain in their natural relation to each other, and in which they are not altered in their texture, nor lined on their inner surface with "polypous layers." "This, however, was not the case in the instance which I have brought forward. In it you have seen that the coats were much dilated, and also very much altered in their structure. Externally and internally, they had assumed the look of the membranes of the fœtus, only they were thicker and denser, but they were equally gelatinous, and nearly as transparent; and, on their inner surface, they were crusted over with laminæ of coagulated lymph. By peeling off this incrustation, after the sac had been inverted, we saw plainly, that, although the internal coats were, round the complete cylinder of the vessel, much diseased, and considerably dilated, yet they were not dilated in the same degree as the external coverings of the artery. At irregular distances, longitudinal rents were formed in the fibrous coats, and these chasms were filled with coagulating lymph. The internal coats, over the whole circumference of the vessel, had assumed the diseased condition which in aneurism is generally confined to a part of the cylinder. In this tumour, all the coats continued for a time to dilate equally; but at length the internal gave way, forming longitudinal rents, through which the external coats could be seen, after the lymphatic coating had been scraped off. In this instance, had the sac been dissected in the early stage, it would have presented precisely the same appearances as those described by Dr. Monro, and the one (the aneurism) lately examined by the surgical editor of the *London Med. Review*." Mr. Burns afterwards expresses doubts, whether the sac ever acquires a large size without dilatation. The case reported in the latter periodical work was the largest that he knew of, in which all the coats were found uniformly dilated. The sac, which was as large as the fist, was lined throughout with flakes of bone; and though the internal coat of the vessel was thus patched, and extremely thin and brittle, it did not, on minute inspection, any where exhibit a solution of continuity. Mr. A. Burns further states, that the above case, reported by himself, was the only one, out of fourteen, which did not corroborate Scarpa's description. (*On Diseases of the Heart, &c.* p. 204.) Mr. Wilson, after mentioning the frequency of aneurism in the aorta, carotid, subclavian, and axillary arteries, and its rarity in the brachial, tells us, that he knows of no example of aneurism below the elbow, where the swelling could not be traced to a wound of the coats of the artery. He adds, that true aneurism has not unfrequently occurred in the internal and external iliac arteries, in the inguinal, femoral, and very frequently in the popliteal. It has taken place in the posterior tibial artery, but he knows of no instance of it in the anterior tibial or peroneal arteries. "I have (says he) met with only one instance of true aneurism affecting any of the branches of the aorta, which are distributed to the abdominal viscera. In the year 1809, on inspecting the body of a clergyman, in the presence of the late Sir W. Farquhar, a tumour, very much resembling the heart in colour, shape, and size, appeared to hang down from the under surface of the left lobe of the liver. When this tumour was opened, and carefully inspected, it appeared to have been formed by the left branch of the hepatic artery having become very much enlarged and aneurismal. It had burst, and the blood which had escaped was found in an imperfect cyst, partly in a fluid, and partly in a coagulated state, forming a large proportion of the tumour." (See *Lectures on the Blood, and on the Anatomy, Physiology, and Surgical Pathology of the Vascular System*, p. 379, 380. 8vo. Lond. 1819.)

The facts adduced by Mr. Hodgson appear sufficiently conclusive, and from them the following doctrine is clearly deducible: —

First, That numerous aneurisms are formed by destruction of the internal and middle coats of an artery, and the expansion of the external coat into a small cyst, which giving way from distention, the surrounding parts, whatever may be their structure, form the remainder of the sac.

Secondly, That sometimes the disease commences in the dilatation of a portion of the circumference of an artery. This dilatation increases until the coats of the vessel give way, when the surrounding parts form the sac, in the same manner as when the disease is in the first instance produced by destruction of the coats of an artery. (P. 74.)

The conclusions of Mr. Hodgson are supported by the observations of numerous writers.

The learned Sabatier says, there can be no doubt, that many aneurisms depend upon the dilatation of the arterial coats; but, *in far more numerous examples, the internal tunics are ruptured, and it is the cellular coat alone which separates from them, and enlarges, so as to form the aneurismal sac.*

It is difficult to conceive, he observes, how all the coats of an artery can dilate and yield sufficiently to form the investment of such immense tumours as some aneurisms are. Indeed, that very tunic, which composes the greater part of the thickness of the vessel, and which is termed the *muscular coat*, is known to consist of fibres whose texture is firm, and little capable of bearing extension. However, Haller, in describing a very large aneurism, situated in the aorta, near the heart, relates, that the innermost coat of this vessel was ruptured and torn, the loose jagged edges of the laceration being visible in the aneurismal sac. These were squamous, bony, and of little thickness; while the muscular and cellular coats were quite sound. Donald Monro noticed the same thing in five different aneurisms, in the course of the femoral and popliteal arteries of a man, who had been confined a long while to his bed, after being operated upon for bubonocele. Monro succeeded in tracing the fibres of the muscular coat over the swellings, so that he had no doubt of this tunic being dilated. (See *Médecine Opératoire*, t. iii. p. 160—162.)

According to Richerand, when an aneurism is recent and of small size, the dissection of the tumour exhibits a simple dilatation of the arterial coats; while, in the other cases, where the aneurism is large, and has existed a considerable time, the internal and middle coats of the vessel are invariably lacerated. In the early stage of the disease, the blood which fills the aneurismal sac is fluid; and, on the contrary, in cases where the internal tunics of the artery are ruptured, the sac contains more or less coagulated lymph. The external or cellular coat composes the greater part of the cyst; and the coagulated lymph, with which it is filled, is arranged in layers, the density of which is described as being greater in proportion to the length of time which they have been deposited. Such as are nearest the sac are, therefore, most compact, and contain the smallest quantity of the colouring matter of the blood; more deeply, the concretions of lymph resembles simple coagula; and, lastly, the blood, which is still nearer the arterial tube, retains its fluidity.

After the aneurismal sac has been cleansed from the fibrine and coagulated blood which it contains, its parietes will appear to be almost entirely formed of the cellular coat of the artery. Towards the bottom may be observed the aperture, arising from the laceration of the internal and middle coats, which, being much less elastic than the external, are ruptured in an early stage of the disease. It is when these two tunics give way, that the aneurismal tumour undergoes a sudden and considerable increase in its size; for, then the cellular coat alone has to sustain all the pressure of the blood, which, now becoming effused into a more ample cyst, loses a great deal of its impetus, coagulates, and forms fibrous masses; circumstances to which may be ascribed the hardness of the swelling, the weakness of its pulsation, &c. (*Nos. Chir.* t. iv. p. 82. ed. 2.)

The reality of true internal aneurisms was insisted upon by C. F. Ludwig, in a programma written expressly on that subject. (*Diagnostices Chir. Fragm. de Aneurysmate Interno*, Lips. 1805.) An interesting case, exemplifying an aneurismal dilatation of all the coats of the abdominal aorta, was published by Professor Nægele of Heidelberg. The swelling was as large as a man's head, and weighed about five pounds. The aorta began to be dilated at the point where it passes into the cavity of the abomen between the crura of the diaphragm. This dilatation extended gradually down to a point, about four finger-breadths from the bifurcation of the aorta into the iliac arteries, at which point, strictly speaking, the large aneurismal sac commenced. The length of the whole dilated part of the vessel was eleven inches; that of the sac six; and its diameter five inches. The artery was not equally dilated in every direction, the expansion being most considerable laterally and forwards. Nægele and Ackermann found that the three coats of the aorta, the internal, muscular, and cellular, were all equally dilated. These professors traced the muscular coat with the scalpel from the top to the bottom of the tumour, and not the slightest doubt could be entertained that the case was a true aneurism. (*F. C. Nægele, Epistola ad T. F. Baltz, quâ Historia et Descriptio Aneurysmatis, quod in Aorta abdominali observavit, continetur.* Heidelb. 1816.)

In the valuable cases collected by H. F. Janin, convincing evidence will be found of there being one kind of aneurism attended with rupture of the coats of the artery, the cellular coat alone forming the aneurismal sac; and another with an equal dilatation of all the coats of the artery. Of the latter, Janin relates three unequivocal cases. (See *Annales du Cercle Médical*, t. i. art. 2. 1820.) Breschet's investigations, which are supported by the evidence of *post mortem* examinations, leave also no doubt about the truth of aneurism by dilatation, of which he describes not less than four kinds, as already stated, viz. the *aneurisma verum sacciforme;* the *aneurisma verum fusiforme;* the *aneurisma verum cylindroidum* (comprising aneurism by anastomosis and erectile tumours); and, lastly, the *aneurisma cyrsoideum*, or the *varix arterialis* of Dupuytren; a rarer affection, in which the arteries undergo very similar changes to those exhibited in varicous veins. (*Breschet, in Mém. Chir. sur différentes Espèces d'Aneurysmes*, 4to. Paris, 1834.) Lisfranc also admits, with all the best modern surgeons, the reality of aneurism accompanied by dilatation of all the coats of the arteries. (*De l'Oblitération des Artères dans les Aneurismes*, p. 11.)

After the clear demonstration of an aneurismal sac being occasionally composed of all the coats of an artery, as afforded in the dissections and pathological preparations, to which a reference has been made, the reader will be better prepared to judge of the difference existing upon this subject between Scarpa and other modern writers; and, so far as I can judge, the question is now reduced to one,—whether any of the dilatations on record, said to comprise all the arterial coats, merit the name of aneurism. We have seen, that he has always unequivocally admitted, that the arteries may be dilated; though the kind of dilatation, to which he alludes, is thought by him, as well as by A. Burns, and my friend Mr. Hodgson (*On Diseases of Arteries, &c.* p. 58.), to require discrimination in a pathological point of view. "It is proved (says Scarpa) by dissection, that the morbid dilatation is circumscribed by the proper coats of the diseased artery; and that the inner surface of the sac, formed by the *partial*, or total protrusion of the arterial tube, is never filled with polypous laminæ, or layers of fibrine disposed over each other; (a fact particularly dwelt upon by Mr. Hodgson, p. 82.;) which layers never fail to be formed in greater or smaller quantity in the cavity of an aneurism." The opinion, that these layers of coagula are not met with in small dilatations of arteries, but are found in large expansions of them, he says, is contradicted by numerous careful observations, and especially by a specimen, actually before him when he was writing, where a morbid dilatation of the arch of the aorta, in the vicinity of its origin from the heart, six inches in length, and five in breadth, was entirely free from any of the lamellated coagula always found in aneurisms. On the contrary, the sac of the aneurism is formed from the parts surrounding the wounded, or ruptured artery, into which pouch the blood, entering as into a natural receiver, and quite out of the current of the circulation, moves only slowly, and constantly deposits these layers of fibrine, and this sometimes in such quantity as to fill the whole cyst. Scarpa at the same time particularly explains, that, if accidentally furrows, or fissures, exist on the inside of the morbid dilatation, the fibrine may be deposited in these rough places, but only in them. These fissures and inequalities of the internal surface of the morbidly dilated artery, he regards strictly as so many beginnings of another disease of the vessel, quite different from dilatation, that is, of aneurism subsequent to dilatation. (See *Memoria sulla Legatura delle principali Arterie degli Arti, con una Appendice all' Opera sulle Aneurisma*, fol. Pavia, 1817; or the *Treatise on Aneurism, transl. by Wishart*, ed. 2. p. 119. Edinb. 1819.)

In this manner, no doubt, Scarpa would account for the presence of lamellated coagula in the case reported by Mr. A. Burns (*On Diseases of the Heart*, p. 306.); though the latter gentleman himself, for reasons already detailed in the foregoing pages, did not regard the expansion of all the coats of the artery as corresponding to the morbid dilatation implied by Scarpa. Thus Scarpa further agrees with other modern writers, in admitting the possibility of aneurism becoming ingrafted, as it were, on one of these unnatural dilatations; more than one example of which combination were, indeed, recited in his first work. In that treatise he has asserted, that what he calls morbid dilatation always extends to the whole circumference of the vessel. But this point seems, from the Appendix, to be renounced, as he now observes, "Where the morbid dilatation is *partial*, or on one side of the artery, like a thimble, (for *very frequently*, even in the arch of the aorta, this partial dilatation does not exceed the size of half a bean,) the entrance for the blood into this capsule is as large as the bottom of the sac." (*Transl. by Wishart*, p. 120. ed. 5.) According to Scarpa, when the morbid dilatation occupies the whole circumference of the arterial tube, the tumour always retains a cylindrical or oval form; and, if situated in such manner that it can be compressed, it yields very readily to pressure, and almost disappears; and, after death, is found much smaller than during life. On the contrary, *aneurism*, whether preceded by dilatation or not, *constantly originates from one side of the ruptured artery.* The entrance for the blood is small, compared with the size of the fundus of the sac; the tumour assumes an irregular shape; yields with difficulty to pressure; retains nearly the same size in the dead that it had in the living body; and its sac, instead of becoming thinner as the swelling enlarges — as the coats of an artery do, when they are simply affected with dilatation — attains greater thickness the larger the aneurism grows. These essential differences between the two diseases are illustrated by an interesting case, met with by Vacca, where a patient died with an aneurism of one subclavian artery, and a simple morbid dilatation of the whole circumference of the other. (See *Sprengel, Storia delle Operaz. di Chir. trad. Ital.* parte ii. p. 294.)

When these two different affections are situated in the thorax, or abdomen, it is impossible to discriminate them from each other before death. The symptoms, occasioned by the pressure of the tumour on the viscera must be nearly the same, whether caused by a morbid dilatation, or an aneurism. The means for retarding their fatal termination is also the same in both forms of the disease. With regard to the possibility of cure, however, Scarpa says, that there is great difference; for, when the case is an internal aneurism, there may be some slight hope of a radical cure by the efforts of nature and art, which hope can never be entertained in a case of morbid dilatation; a fact which is accounted for by no laminated coagula being deposited in the latter disease. (*On Aneurism, transl. by Wishart*, p. 124. ed. 2.) A great deal of the latter statement coincides with the observations of Mr. Hodgson, who particularly notices, that he has never met with lamellated coagula in such sacs as consist either in a general or partial dilatation of the coats of the vessel. (*On Diseases of Arteries, &c.* p. 82.) Whether this ever takes place in such cases may still be a question, because, if Professor Nægele has given a correct description of the aneurism of the abdominal aorta, already mentioned — which aneurism was of large size, and consisted of a dilatation of all the coats of the vessel — there was in this rare example a large quantity of these layers of coagulated blood. Yet, whether the Professor actually means the fibrine arranged in laminæ, or only common coagulated blood, which, as every one knows, may be found either in the cysts of dilated or of ruptured arteries, may admit of doubt. The statement, therefore, made by Hodgson and Scarpa, and which agrees with the later observations of Breschet (see *Mém. Chir. sur différentes Es-*

pèces d'Aneurismes, p. 70.), may not be contrary to what was really seen by Nægele and Aekermann. The following case, however, observed by Laennec, and quoted by a modern writer, must (if correctly reported) afford not only an unequivocal specimen of aneurism by dilatation of all the coats of the aorta, but of laminated coagula within its cavity. "In homine enim, qui repentè sub atrocissimis pectoris doloribus corruit, præter aortam adscendentem in aneurysma ita expansam, ut neonati infantis caput æquaret, cystidem aneurismaticam immediatè suprà arteriæ cœliacæ ortam magnitudine nucis juglandis invenit, quæ luculenter ostendit sinum communicantem eum arteriæ cylindro per foramen magnitudine amygdalæ, diametro totius arteriæ illo loco non mutato. Saccus hic cultro anatomico accuratè ac subtiliter subjectus, eamdem structuram, easdem ostendit membranas, quibus gaudebat arteria, e cujus latere excreverat; cæterum *massis grumosis sive fibrosis erat impletus*. Inde igitur patet, hoc aneurysma sacciforme et laterali et partiali quidem tunicarum aortæ dilatatione ortum esse." (*J. H. G. Ehrhardt, De Aneurysmate Aortæ*, p. 13. 4to. Lips. 1820.)

Certainly, it seems difficult to explain in what the difference consists, which prevails between the state of the internal coat, in *preternatural* dilatation, and in *true* aneurism, so that the blood does not coagulate in the former, while it is deposited in concentric layers in the latter. (See *Guthrie on Dis. of the Arteries*, p. 85.) Perhaps, says the latter gentleman, there is not at a late period any difference between a preternatural dilatation or bulging on one side of an artery, and a true aneurism; a state remarkably well shown in one of the preparations in the College Museum, No. 411. H.; and he adds, "At all events, preternatural dilatations of a large size, and departing from the course of the vessel from which they arise, do generally lose their distinguishing character of freedom from concentric layers of coagula, so that the distinction between them, under these circumstances, is lost;" unless we regard it, with Scarpa, as essentially founded on the existence of fissures in the internal coat in the aneurism, and of the absence of such change in the simple dilatation.

From what has been stated, then, it appears that there is only one principal point of difference between Scarpa and other writers; and this resolves itself into the question, whether a dilatation of an artery, arising at one particular side of the vessel, and lined by its internal coat, ought not to be regarded as an aneurism, because its communication with the tube of the artery is more capacious than what exists in other aneurisms, where the inner coat has given way, and because it rarely (perhaps never) contains laminated coagula, unless fissures happen to exist at some points of the inner arterial tunic thus expanded?

The greater number of aneurisms increase gradually, and sooner or later incline to the side on which the least resistance is experienced. De Haen mentions an aneurism of the aorta, which first made its appearance between the second and third ribs of the left side, and which, instead of growing larger, as is usual, subsided, and could neither be seen nor felt, for more than a month before the patient's disease, although, on opening the body, a tumour of the arch of the aorta was found, three times as large as the fist. De Haen imputes the sudden disappearance of the swelling to its weight, the yielding of the parts with which it was connected, and to its gravitating into the chest when the patient lay on his right side; for the difficulty of breathing, and other complaints, produced by the pressure on the lungs, underwent a material increase as soon as the tumour ceased to protrude.

The pulsations, which accompany true aneurisms, continue to be strong, until the inner coats of the vessel give way, or the layers of coagulated blood lodged in the sac are numerous. Hence, when soft swellings, situated near any large arteries, lose their pulsatory motion, their course, precise situation, and other circumstances, ought to be most carefully investigated, before any decision is made about the mode of treatment.

A few years ago, I saw a man in St. Bartholomew's Hospital, who had a large swelling of great solidity, occupying the ham, and apparently extending a good way forwards round the condyles of the femur. Its hardness, shape, large size, and entire freedom from pulsation, not only then, but at an earlier period, so far as could be collected from the patient's own account, led to the belief that the case was probably a tumour complicated with exostosis of the femur; and as this opinion seemed to be confirmed by no fluid escaping from a puncture made with a lancet, amputation was performed. To our surprise, however, dissection proved that the disease was a large popliteal aneurism, in which the spontaneous cure by an obliteration of the sac with coagula, was taking place. (See *Lawrence, Med. Chir. Trans.* vol. viii. p. 497.)

In many instances, the most fatal accidents have happened, in consequence of incisions having been made in aneurisms, which were mistaken for abscesses, because there was no pulsation. Vesalius was consulted about a tumour of the back, which he pronounced to be an aneurism. Soon afterwards, an imprudent practitioner made an opening in the swelling, and the patient bled to death in a very short time. Ruysch relates, that a friend of his opened a tumour near the heel, not supposed to be an aneurism, and the greatest difficulty was experienced in suppressing the hemorrhage. De Haen speaks of a patient, who died in consequence of an opening, which had been made in a similar swelling at the knee, although Boerhaave had given his advice against the performance of such an operation. Palfin, Schlitting, Warner, Dupuytren, and others, have recorded mistakes of the same kind. (*Sabatier*, t. iii. p. 167.) Ferrand, surgeon of the Hôtel Dieu, mistook an axillary aneurism for an abscess, plunged his bistoury into the swelling, and killed the patient. "*J'ai été témoin d'erreurs semblables, commises par les practiciens non moins fameux; et si des anéurismes externes on passe à ceux des artères placées à l'intérieur, les erreurs ne sont ni moins ordinaires ni de moindre conséquence.*" (*Richerand, Nosogr. Chir.* t. iv. p. 75. ed. 2.)

Notwithstanding a pulsation is one of the most prominent symptoms of an aneurism, it is not to be inferred, that every swelling which pulsates is unquestionably of this description; for, as Mr. Warner has explained, it does happen that mere imposthumations, or collections of matter, arising from external as well as internal causes, are sometimes so immediately situated upon the heart itself, and at other times upon some of the principal arteries, as to partake, in the most regular manner, of their contraction and dilatation. He details the particulars of a boy, about thirteen years of age, whose breast-bone had been badly fractured, and who was admitted into Guy's Hospital, a fortnight after the accident had happened. The broken parts of the bone were removed some distance from each other. The intermediate space was occupied by a tumour of a considerable size; the integuments were of their natural complexion. The swelling had as regular a contraction and dilatation as the heart itself, or the aorta could be supposed to have. Upon pressure, the tumour receded; upon a removal of the pressure, the tumour immediately resumed its former size; all these are allowed to be distinguishing signs of a recent true aneurism. The situation and symptoms of this swelling were judged sufficient reasons for considering the nature of the disease as uncertain; on which account it was left to take its own course. The event was, the tumour burst in about three weeks after his admission; discharged a considerable quantity of matter; and the patient did well by very superficial applications. (*Cases in Surgery*, ed. 4. p. 155.)

An extraordinary form of disease, having very much the appearance of an aneurism, sometimes presents itself. A swelling, attended with considerable pain, and a strong pulsation, is gradually produced high up the arm; and, at length, attains a very large size. The strength of the throbbings at first leads to the suspicion, that the case must be an aneurism; but, on careful examination, the humerus is found to have given way at a point involved in the disease, and here to be as flexible as if there were a fracture. This circumstance, and the extension of the swelling too far away from the track of the artery, in time raise doubts about the case being an aneurism. The patient ultimately falls a victim to the effects of the disease on the constitution, and, when the arm is dissected after death, the tumour is found to consist of a sarcomatous or medullary mass, occupying the central portion of the limb, and accompanied with a solution of continuity extending completely through the whole thickness of the bone. Two cases of this description were admitted into St. Bartholomew's Hospital, in the year 1820. One of these patients, a woman, I had an opportunity of seeing; and, after her death, the real nature of the disease was proved by dissection. My friend, Mr. Vincent, has seen a similar disease in the leg, resembling aneurism in the circumstance of pulsation, but attended with destruction of a part of the tibia, and a moveableness of the separated ends of the bone. This form of disease has sometimes led very experienced surgeons to mistake the disease for aneurism, and to take up the artery. Thus, Dr. Nicol, of Inverness, who was deceived in this way, has laid the particulars of the case before the profession, with a kind of candour, which I sincerely admire, as ten times more useful in the promotion of surgical knowledge, than a boastful recital of nothing but fortunate practice. (See *Case of Medullary Sarcoma, engaging the Upper Portion of the Os Humeri, considered Aneurismal, and for which the Subclavian Artery was tied above the Clavicle, Edin. Med. and Surg. Journ.* No. 120. p. i. 1834. See also *J. G. Guthrie on a Case of Malignant Tumour, simulating an Aneurism, in which the common Iliac Artery was tied, London Med. Gaz. for* 1834, p. 590.)

Under certain circumstances, a psoas abscess may be mistaken for an aneurism; as, for instance, when it occasions a small, soft, moveable swelling over the femoral artery in the groin, accompanied by a strong pulsatory motion. The tumour may be lessened by pressure, even in the erect position, and rapidly returns on the discontinuance of such pressure, as would be the case in aneurism. The pulsation is manifest; but, after the swelling has been lessened by pressure, its sudden resumption of size in the erect position is not accompanied by the peculiar pulsatory thrill felt in an aneurism. In a psoas abscess, the swelling does not return in the same degree on the removal of the pressure, as in a case of aneurism. During the retrocession of the purulent fluid, the course of the artery may be more readily examined. In cases of psoas abscess, the swelling has generally been preceded by pains in the back and loins, of some standing, which continue with weakness of one or both extremities. (See *Guthrie on Dis. of Arteries*, p. 120.)

I remember a large abscess in the situation of the quadratus lumborum muscle, which pulsated so strongly, that the case was supposed by several experienced men to be an aneurism of the abdominal aorta. The patient was a boy in Christ's Hospital, and under the care of the late Mr. Ramsden, surgeon to that establishment, by whose discernment the real nature of the case was detected. It is curious, that, in this instance, the pulsations of the swelling suddenly ceased, after having continued in a very strong and manifest way, and without interruption for several weeks, during which it was under the observation of the above eminent practitioner. Four or five years ago I was consulted by Mr. Gilbertson of Egham, about a young man who had a vast swelling in the epigastric, hypochondriac, and superior part of the umbilical regions, attended with strong and regular pulsations. The disease had come on without much pain, or any derangement of the functions of the abdominal viscera. A fluctuation was perceptible in it, and one part of the tumour was tending to point, and very thin. The patient, when a child, had had a scrofulous disease of the hip. We inferred, therefore, that the case was a chronic abscess. The tumour soon burst; the quantity of matter discharged was several quarts; but the patient ultimately recovered.

As Mr. Wilson has observed, any encysted, or even solid tumour, situated in the neighbourhood of, or upon, a large artery, may have a considerable degree of motion communicated to it from the pulsation of the artery. The thyroid gland, when a bronchocele is formed, occasionally receives a pulsatory motion from the carotid arteries. This may be mistaken for an aneurism; from which disease, however, it can be discriminated by placing our fingers behind the tumour, and drawing it forwards, when the pulsation ceases. But there are other criteria for distinguishing a swelling, on or near an artery, from an aneurism. In such a case the whole tumour moves at once, without any alteration of size. In an aneurism, the swelling does not simply move, it expands. A tumour of the thyroid gland, having apparently a pulsatory motion, may be known not to be an aneurism of the carotid, by observing, that, from its connection with the larynx, it follows the movements of the latter in deglutition. Aneurisms, not of very long standing, and not containing a large mass of laminated coagula, may also be diminished, or rendered more or less flaccid, by pressing the artery leading to the disease. (See *Wilson on the Blood, Anatomy, Pathology, &c. of the Vascular System*, p. 385.; and *Burns on the Heart*, p. 257.) In cases of much ambiguity, the stethoscope will sometimes convey the necessary information. In a doubtful instance of aneurism of the groin, Sir Benjamin Brodie found all obscurity cease on the application of this instrument. (*Sir A. Cooper's Lectures*, vol. ii. p. 46.)

The following case, recorded by Pelletan, shows that an artery, running more superficially than natural, may, under particular circumstances, give rise to the suspicion of an aneurism. A strong robust man, about forty years of age, was in the habit of going on foot to dine three leagues from Paris every day, on the completion of his business. One day, having been this distance, and returned, he felt an acute pain along the leg, and in the right ankle. The pain did not subside, and a tumour appeared at the lower third of the leg, opposite the space between the two bones. The skin was of a yellowish colour from effused blood, and a pulsation existed, by which the hand of an examiner was lifted up. There seemed great reason for concluding, that the case was an aneurismal swelling. In comparing the affected limb with the sound one, however, Pelletan perceived in the latter a similar kind of throbbing. In short, in both legs, the pulsation of an arterial tube could be felt for three inches; and Pelletan distinctly ascertained, that, in the diseased member, the throbbing did not extend to the whole of the tumour, but only lengthwise. By a particular disposition in this individual, the anterior tibial artery, which usually runs along the interosseus ligament, covered by the tibialus anticus, and extensor communis digitorum pedis, came out from between these muscles, at the middle of the leg, and lay immediately under the skin and the fascia.

The swelling and ecchymosis gradually dispersed, and the symptoms were supposed to originate from the rupture of some muscular fibres. (*Clinique Chir.* t. i. p. 101, 102.)

Whenever an aneurism of immoderate size beats strongly, and for a long while, against the bones, as the sternum, ribs, clavicle, and vertebræ, they are in the end injured or destroyed, the aneurismal tumour elevating the integuments of the thorax, or back, and pulsating immediately under the skin. Scarpa, with the best modern writers, attributes the effect to absorption, in consequence of the pressure.

J. L. Petit saw the condyles of the femur, and the upper head of the tibia, almost destroyed by an aneurism of the popliteal artery; and another case, in which the absorption of bone was remarkably extensive, is reported by Rosenmüller. (*Anhang. zu Scarpa üb. d. Pulsadergeschwulste*, p. 364.) The carious and corroded state of the bones in aneurism is never attended with the formation of pus; "at least, the discovery of pus in its vicinity has not been remarked by those who have examined such cases. In this respect, therefore, it differs essentially from common caries, or ulceration of bones. Exfoliation also is very rarely attendant upon it: from which circumstance, one important practical observation is deducible, namely, that if the aneurism be cured, the bones will recover their healthy state, without undergoing those processes which take place in the cure of caries or necrosis. (See *Hodgson on the Dis. of Arteries and Veins*, p. 80.) That this process of absorption in bone, in consequence of the pressure of an aneurism, may be caused by other tumours, is finely exemplified in a thigh-bone preserved in the Museum of the London University. The bone has been reduced by the pressure of a tumour, which grew at the back of the limb, to a mere spindle, that has not been able to resist the efforts of the muscles, by which it has been twisted in a singular degree. The absorption of bone from the pressure of aneurisms, is of that description, termed by Mr. Hunter *progressive* (see Absorption), in which, as Mr. Guthrie observes, the action of the small arteries, necessary to constitute inflammation, is wanting, and consequently there is little comparative pain at the commencement of the process, and no formation of matter. (See *Guthrie on Diseases of Arteries, &c.* p. 57.)

Mr. Hodgson confirms the remark made by Dr. W. Hunter (*Med. Obs. and Inquiries*, vol. i. p. 384.), Scarpa (*On Aneurism*, p. 100. ed. 2.), and others, that cartilage is less rapidly destroyed by the pressure of an aneurism than bone. This fact is strikingly illustrated in a case of aneurism of the thoracic aorta recorded in another modern publication: the bodies of the vertebræ, from the fourth down to the ninth were carious; the four lowest in particular; yet the intervertebral cartilages were not materially affected. (*F. L. Kreysig, Die Krankheiten des Herzens*, b. iii. p. 176. 8vo. Berlin, 1817.) In the museum of the London University are fine specimens of the perfect state of the intervertebral substance, though the bodies of the vertebræ have greatly suffered.

A case is related by Pelletan, to which I refer the reader, as exemplifying not only the degree, in which internal aneurisms may injure the vertebræ, but also the occasional possibility of such diseases being mistaken for rheumatism, or a lumbar abscess. (See *Clinique Chir.* t. i. p. 97—100.)

Causes of Aneurism.

An aneurism will not follow the kind of weakness of its sides, which must necessarily arise from removing its external and middle coat, some morbid changes seeming to be essential to bring on a protrusion of the inner coat. Neither will a mechanical division of the inner tunics lead to an aneurismal dilatation of the outer coat. The latter fact is proved by what happens when a tight ligature is placed upon an artery, as well as by the experiments of M. Amussat who purposely broke the internal coats in numerous places, by pinching the vessels with forceps, and detaching the inner coats from the outer, by a process somewhat similar to what he adopts in torsion of the arteries. By proceedings of this kind, he never succeeded in producing the beginning of an aneurism. The inference, therefore, is, that some description of morbid change in the coats of the artery is necessary for the formation of aneurism, so long as the occurrence is resisted by a perfect state of one of those coats; or else we must arrive at the still more certain conclusion, that in the experiments undertaken by Hume, Amussat, and others, the irritation of the artery was followed by inflammation of it, coagulation of the blood, and such an effusion of fibrine, within and around it, as would fully account for no aneurismal tumour being the result.

One very interesting point, in relation to spontaneous aneurism, and particularly adverted to by M. Malgaigne, is the almost exclusive restriction of this disease to the aortic system. Thus, in more than three hundred aneurisms, observed by M. Lisfranc, or recorded by others, he has met with only two instances of an aneurismal disease of the pulmonary artery, and these not free from objection. (*Lisfranc, des diverses Méthodes, &c. pour l'Oblitération des Artères*, p. 8. 8vo. Paris, 1834.) This remarkable fact is suspected to depend upon the aortic arteries containing, between their inner and fibrous coats, a dense, hard, fragile tissue, only capable of being taken off in scales, and designated by M. Malgaigne the *sclerous* coat. When concretions of different kinds, calcareous, steatomatous, or cartilaginous, present themselves in the aorta, they are seated, according to M. Malgaigne, almost exclusively, in this sclerous coat, a texture not existing in the pulmonary artery or its branches.

In many instances, it is difficult to assign any cause for the commencement of aneurism. Among the circumstances, which predispose to the disease, however, the large size of the vessels may undoubtedly be reckoned. Those trunks, which are near the heart, have much thinner parietes, in relation to the magnitude of the column of blood with which they are filled, than arteries of smaller diameter; and since the lateral pressure of this blood against the sides of the arteries is in a ratio to the magnitude of these vessels, it follows, that aneurisms must be much more frequent in the trunks near the heart, than in such as are remote from the source of the circulation. (*Richerand, Nosogr. Chir.* t. iv. p. 72. edit. 2.) The whole arterial system is liable to aneurisms; but, says Pelletan, experience proves, that internal arteries are much more frequently affected, than such as are external. (*Clinique Chir.* t. i. p. 54.)

The curvatures of the arteries are another predisposing cause of the disease, and have a manifest effect in determining the formation of the great sinus of the aorta, the dilatation, which exists between the arch and the origin of this large artery, and which is the more considerable the older the person is: Monro even thought, that one half of old persons have an aneurism at the beginning of the aorta. And with respect to aneurisms in general, which are preceded by calcareous depositions thickening, and disease of the coats of the vessel, they are most frequent in persons of advanced age. Aneurisms from wounds are of course often seen in individuals of every age. In old people, the coats of the arteries are subject to a disease, which renders them incapable of making due resistance to the lateral impulse of the blood. The disease here alluded to is what is described in a foregoing part of this article; one common effect of which is the deposition of calcareous matter between the inner and muscular coats of the arteries, or in the sclerous coat of Malgaigne. "People in the early part of life," says Mr. Wilson, "are not very subject to these calcareous depositions; but, I have occasionally met with them in the arteries of very young people. I have seen a well-marked deposition of the phosphate of lime in the arteries of a child under three years of age." He adds, that few persons, above the age of sixty, are free from these ossifications. (*On the Blood, and on the Anatomy, Pathology, &c. of the Vascular System*, p. 375. Lond. 1819.)

Though spontaneous aneurisms are most common in old persons, the disease is not absolutely confined to them; for I assisted Mr. Docker of Canterbury in an operation for the cure of a popliteal aneurism in a postillion, whose age must have been under thirty; and Mr. Wilson says that he has met with several instances of the disease in the aorta and other vessels, where the patients were not more than forty years of age. (*Op.* cit. p. 376.)

According to Sir Astley Cooper, the time of life when aneurism generally occurs, is between the ages of thirty and fifty; an age, when exercise is considerable, and strength on the decline. In very old age the disease is not so common. However, he operated successfully on a case of popliteal aneurism, where the patient was eighty-four or eighty-five years old. He operated, with success, on another man, sixty-nine years of age. He has also seen a boy, only eleven years old, with aneurism of the anterior tibial artery. The man of more than eighty is the oldest, and the boy of eleven the youngest, aneurismal patients he has ever seen. (See *Lectures*, vol. ii. p. 40.)

On the subject of the comparative frequency of aneurism at various periods of life, M. Lisfranc refers to 120 cases, in which the age of the patient is specified, and from which he drew up the annexed table: —

Age.	Cases.	Age.	Cases.
13	1	40 to 45	20
15 to 20	3	45 to 50	17
20 to 25	5	50 to 55	11
25 to 30	12	55 to 60	6
30 to 35	24	60 to 70	3
35 to 40	15	70 to 80	3

Thus, M. Lisfranc finds, what Sir Astley Cooper had ascertained long ago, that aneurisms are most common between the ages of thirty and fifty; that ten years on one side or the other of these ages make a remarkable difference,—under twenty, and after sixty, the disease being exceedingly rare. Aneurisms by anastomosis, however, which are entirely a different affection from the cases now under consideration, are chiefly met with in children and young persons under fifteen, and seldom in adults. M. Lisfranc knows of no example of anuerism by anastomosis in an old person. (*De l'Oblitération des Artères, &c.* p. 12, 13.)

Richerand affirms, that, out of twelve popliteal aneurisms, which he had seen in hospital or private practice, ten were caused by a violent extension of the leg. This statement, he says, will derive confirmation from the following experiment. Place the knee of a dead subject on the edge of a firm table, and press on the heel, so as forcibly to extend the leg, far enough to make the ligaments of the ham snap. Now dissect the parts, cut out the artery, and examine its parietes in a good light, when the laccrations of the middle coat will be observable, and rendered manifest by the circumstance of those places appearing semitransparent, where the fibres are separated, the parietes at such points merely consisting of the internal and external tunics. (*Nosogr. Chir.* t. iv. p. 73, 74. ed. 2.) But the insufficiency of this explanation is clear enough from the fact, that such violence, as is requisite to break the ligaments of the knee, cannot be imagined to happen in the accidents which ordinarily bring on aneurism in the ham.

The implicit belief of Richerand, that the laceration of the middle coat of an artery will bring on an aneurism, while the inner coat is perfect, will appear to be unfounded, when Amussat's experiments are remembered, and also those of Hunter, Home, and Scarpa, who even dissected off the external and middle coats of arteries, without being able in this manner to cause an aneurism. Nay, where the experiment has been made of applying a tight ligature to an artery, and immediately removing it again in order to determine whether the division of both the inner coats of the vessel would terminate in an obliteration of the tube of the vessel, no aneurism has been the consequence.

Pelletan accounts for the frequency of popliteal aneurisms somewhat differently from Richerand: speaking of the two principal motions of the knee, viz. extension and flexion, he remarks, that the first of these is so limited, that it is actually an incipient flexion necessarily produced by the curvature backward both of the condyles of the femur, and those of the tibia. This curvature, which would seem to protect the popliteal artery against any dangerous elongation, that might otherwise be caused by a forcible extension of the joint, becomes the very source of such an elongation, in persons who are accustomed to keep their limbs bent, or who, from this state, proceed hastily and violently to extend the leg. The arterial tubes are really shortened, when the limbs are in the state of flexion, and lengthened, when the extension of the members renders it necessary. Hence, says Pelletan, it is manifest, that an habitually shortened state of these vessels, and their sudden elongation, must be attended with hazard of rupturing their parietes. (*Clinique Chirurgicale*, t. i. p. 112.)

The opinion of Pelletan, however, is quite untenable; because Mr. Hodgson has several times repeated the experiment mentioned by Richerand, and found, as this gentleman did, that the coats of the artery were never lacerated, unless the degree of violence had been such as to rupture the ligaments of the knee. (*On Diseases of Arteries, &c.* p. 64.)

Aneurisms are exceedingly common in the aorta, and they are particularly often met with in the popliteal artery. The vessels which are next to these most usually affected, are the crural, common carotid, subclavian, and brachial arteries. The temporal and occipital arteries, and those of the leg, foot, forearm, and hand, are far less frequently the situations of the present disease. But, although it is true, that the larger arteries are the most subject to the ordinary species of aneurisms, the smaller arteries seem to be more immediately concerned in the formation of one peculiar aneurismal disease, now well known by the name of *aneurism by anastomosis*, of which I shall hereafter speak.

According to surgical writers, the causes of aneurisms operate either by weakening the arterial parietes, or by increasing the lateral impulse of the blood against the sides of these vessels. It is said to be in both these ways, that the disease is occasioned by violent contusions of the arteries, the abuse of spirituous drinks, frequent mercurial courses, fits of anger, rough exercise, exertions in lifting heavy burthens, &c. In certain persons, aneurisms appear to depend upon a particular organic disposition. Of this description was the subject, whose arteries, on examination after death, were found by Lancisi affected with several aneurisms of various sizes. I have known a person have an aneurism of one axillary artery, which disease got spontaneously well, but was soon afterwards followed by a similar swelling of the opposite axillary artery, which proved fatal. I have seen another instance, in which an aneurism of the popliteal artery was accompanied with one of the femoral in the other limb. Boyer mentions a patient, who died of a femoral aneurism in La Charité, at Paris, and who had also another aneurism of the popliteal artery, equal in size to a walnut. (*Traité des Maladies Chir. &c.* t. ii. p. 102.) The greatest number of aneurisms that Sir Astley Cooper has seen in one patient is seven; and it is a remark made by this eminent surgeon, that when an aneurism occurs in the ham, the disease is frequently of a local nature; but that, when it is between the groin and ham, disease of other arteries is very commonly met with. (See *Lectures*, vol. ii. p. 37.) One memorable case, proving the existence of a disposition to aneurisms in the whole arterial system, is mentioned by Pelletan: "J'ai pourtant vu plusieurs fois ces nombreux aneurismes occupants indistinctement les grosses ou les petites artères, mais surtout celles de capacité; *j'en ai comté soixante-trois sur un seul homme, depuis le volume d'une aveline jusqu'à celui de la moitié d'un œuf de poule.*" (*Clinique Chir.* t. ii. p. 1.) M. Jules Cloquet relates a case, in which all the arteries were covered with aneurismal tumours, from the size of a hemp-seed to that of a large pea. Some existed on the aorta; but larger numbers on the arteries of the limbs. Altogether, there were some hundreds of them. Excepting in the situations of the tumours, the structure of the arterial coats had undergone no alteration. Here they were dilated and thinned. In none of them was any rupture of the internal or middle coat observed. The dilatations were continued into the small arteries, in which, however, they were less conspicuous than in those of superior size. (See *J. Cloquet, Pathologie Chir.* p. 86. pl. 2. 4to. Paris, 1831.) These aneurisms corresponded to the sacciform aneurisms of Breschet.

Aneurisms, and those diseases of the coats of arteries which precede the formation of aneurism, are much less frequently met with in women than in men. (*Lassus. Pathologie Chir.* t. i. p. 348.) A few years before John Hunter died, Mr. Wilson heard him remark, that he had only met with one woman affected with *true* or spontaneous aneurism. (*Anatomy, Pathology, &c. of the Vascular System*, p. 376.) Mr. Hodgson drew up the following table, exhibiting the comparative frequency of aneurisms in the two sexes, in different cases of this disease, and also in the different arteries of the body, as deduced from examples, either seen by himself, during the lives of the patients, or soon after their death :—

	Total.	Males.	Females.
Of the ascending aorta, the arteria innominata, and arch of the aorta -	21	16	5
Descending aorta -	8	7	1
Carotid artery -	2	2	0
Subsclavian and axillary -	5	5	0
Inguinal artery -	12	12	0
Femoral and popliteal -	15	14	1
	63	56	7

This table does not include aneurisms arising from wounded arteries, nor aneurisms by anastomosis. (*On the Diseases of Arteries and Veins*, p. 87.) Sir Astley Cooper confirms the fact of the much greater frequency of aneurism in the male, than the female sex. Women, he says, rarely have aneurism in the limbs. In forty years' experience, he has seen only eight cases of popliteal aneurism in women, but an immense number in men. Most of the aneurisms which he has seen in females have been in the ascending aorta, or the carotids. (*Lectures*, vol. ii. p. 41.) Mr. Guthrie has met with but three popliteal aneurisms in women ; and he calculates that aneurism of the ham occurs from twenty to thirty times in men for once in women. "The structure of the vessels (he observes) is the same, but the mode of life is different. The exertion in general is infinitely greater in the man than the woman ; and, I think this, combined with the freer use of ardent spirits, a much more likely cause than either syphilis or mercury." (*On Dis. of Arteries*, p. 87.)

In relation to the comparative frequency of aneurism in the two sexes, M. Lisfranc states, that in 154 cases, the particulars of which have been collected by him, and whose situations brought them within the reach of operative surgery, the proportion of male patients was 141 ; of females 13 ; or nearly as 11 to 1.

With respect to the comparative frequency of aneurism in different arteries, M. Lisfranc refers to 179 cases, all spontaneous, those of the aorta not entering into the computation ; from which 179 cases he gives the following table : —

1. Popliteal artery - - -		59
2. Femoral	in the groin -	26
	at other points -	18
3. Carotid - - - -		17
4. Subclavian - - -		16
5. Axillary - - - -		14
6. External iliac - -		5
7. Brachio-cephalic - -		4
8. Brachial - - -		3
9. Common iliac - -		3
10. Anterior tibial - -		3
11. Gluteal - - -		2
12. Internal iliac - - -		2
13. Temporal - - -		2
14. Internal carotid - - -		1
15. Ulnar - - -		1
16. Peroneal - - -		1
17. Radial - - -		1
18. Palmar arc - -		1

It was observed by Morgagni, and it has been noticed in this country, that popliteal aneurisms occur with particular frequency in postillions and coachmen whose employments oblige them to set a good deal with their knees bent. In France, the men, who clean out dissecting-rooms, and procure dead bodies for anatomists, are said almost all of them to die of aneurismal diseases. Richerand remarks, that he never knew any of these persons, who were not addicted to drinking. (*Nosogr. Chir.* t. iv. p. 74. ed. 2.)

Aneurisms are supposed by M. Roux to be much more frequent in England than in France ; a circumstance, which he refers to the mode of life, and kind of labour, to which a large part of the population of England is subjected. Indeed, he connects this surmise with a reason for the very cultivated state of this part of knowledge in England ; thinks that we have been placed in favourable circumstances for perfecting the treatment of aneurisms ; and acknowledges that we have contributed more than his countrymen, both in the last and present century, to the improvement of this branch of surgery. (*Roux, Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise, &c.* p. 249. (But, ere M. Roux ventured into such conjectures, he ought at least to have specified what particular occupations and kind of labour are known by Englishmen themselves to be frequently conducive to aneurism ; for, with the exception of postillions and coachmen, of whom there is also abundance in France, I am not aware that any determinate class of persons is found in this country to be affected with particular frequency.

In some instances, axillary aneurisms seem to have arisen from violent extension of the limb. (See *Pelletan, Clinique Chir.* t. ii. p. 49. and 83.) In other examples, related by the same practical writer, aneurism arose from reiterated contusions and rough pressure on parts. (*Op.* cit. p. 10. and 14. Also *Guthrie on Dis. of Arteries.*)

The extremity of a fractured bone may injure an artery and give rise to an aneurism ; instances of which are recorded by Pelletan (*Op.* cit. t. i. p. 178.) and Duverney (*Traité des Mal. des Os*, t. i.). In Pelletan's case, the disease followed a fracture of the lower third of the leg. An aneurism of the anterior tribial artery, from such a cause, is also described by Mr. C. White. (*Cases in Surgery*, p. 141.)

The following case of an aneurism of the humeral artery after amputation, is recorded by Warner :—C. D. was afflicted with a caries of the joint of the elbow, which was attended with circumstances rendering amputation necessary. The operation was performed at a proper distance above the diseased part, and the vessels were taken up with needles and ligatures. — In a few days the humeral artery became so dilated above the ligature upon it, as to be in danger of bursting. Hence it was judged necessary to perform the operation for the aneurism, which was done, and the vessel secured by ligature, above the upper extremity of its distended coats. Every thing now went on, for some time, exceedingly well ; when suddenly the artery again dilated, and was in danger of bursting above the second ligature. These circumstances made it necessary to repeat the operation for the aneursim. From this time every thing went on successfully, till the stump was on the point of being healed ; when, quite unexpectedly, the artery appeared a third time diseased in the same manner as it had been previously, for which reason, a third operation for aneurism was performed, followed by no relapse. "Could the several aneurisms of the humeral artery (says Mr. Warner) be attributed to the sudden check alone, which the blood met with from the extremity of the vessel being secured by ligature? or is it not more reasonable to suppose, that the coats of the artery, nearly as high up as the axilla, were originally diseased and weakened?" The latter seemed, to this judicious writer, the most probable way of accounting for the successive returns of the disease of the vessel: since it is found from experience, that such accidents have been very rarely known to occur after amputation either of the arm or thigh, where nearly the same resistance must be made to the circulation in every subject of an equal age and vigour, who has undergone such operation. If it were supposed, that the several dilatations of the coats of the vessel arose merely from the check in the circulation, it appeared to Mr. Warner not easy to account for the final success of this operation; especially when we reflect, that the force of the blood is increased in proportion to its nearness to the heart. (See *Cases in Surgery*, p. 139, 140. ed. 4.) Ruysch has related an observation somewhat similar. (*Obs. Anat. Chir.* t. i. p. 4.) In 1813, M. Roche published another occurrence of this kind, which happened in the posterior tibial artery. (See *Lisfranc, De l'Oblitération des Artères*, p. 97.)

Aneurisms sometimes follow the injury of a large artery by a gunshot wound. The passage of a bullet through the thigh, in one example, gave rise to a femoral aneurism. (See *Parisian Chirurgical Journal*, vol. ii. p. 109.) The same cause produced an aneurism high up the thigh of a soldier, who was under the care of my friend Mr. Collier, at Brussels, after the battle of Waterloo.

Prognosis.

In cases of aneurism, the prognosis varies according to a variety of important circumstances. The disease may generally be considered as exceedingly dangerous; for, if left to itself, it almost always terminates in rupture, and the patient dies of hemorrhage. There are some examples, however, in which a spontaneous cure took place; and aneurismal swellings have been known to lose their pulsation, become hard, smaller, and gradually reduced to an indolent tubercle, which entirely disappeared. After death, the artery, in such instances, has been found obliterated, and converted into a ligamentous cord, without any vestige of the aneurism being left. Aneurisms are also sometimes attacked with mortification; the sac and adjacent parts slough away; the artery is closed with coagulum; and thus a cure is effected. Lastly, tumours, having all the characters of aneurisms, have been known to disappear under the employment of such pressure as was certainly too feeble to intercept entirely the course of the blood. Such examples of success, however, are not common; and whenever they happen, it is because the entrance of blood into the sac is prevented by the coagulation of that already contained in it, and because the artery above the swelling is filled with coagulum. They must, in fact, have been cured on the very same principle which renders the surgical operation successful.

Nothing is subject to more variety, than the duration of an aneurism previously to its rupture; the tumour bursting sooner or later, according as the patient happens to lead a life of labour, or ease, temperance, or moderation. Even the bursting of an internal aneurism may not immediately kill the patient. A stonecutter died in the hospital Saint Louis with an enormous aneurism, situated on the left side of the lumbar vertebræ. The body was opened by Richerand, who found, that the external tumour consisted of blood, which, after making its way through the muscles, had been effused into a cyst, formed in the midst of the cellular substance of the loins. The track, through which it came, led into another aneurismal sac, contained in the abdomen, and situated behind the peritoneum, on the left side of the lumbar vertebræ. In endeavouring to discover whence the extravasated blood proceeded, Richerand found that the abdominal aorta was entire, though in contact with the swelling. The original affection consisted of an aneurismal dilatation of the thoracic aorta, which had burst at the point where it lies betwixt the crura of the diaphragm. The blood had probably escaped very slowly, and it had accumulated in the cellular substance round the kidney, so that three cysts had burst successively before the patient died. (*Nosorg. Chir.* t. iv. p. 82. ed. 2.)

Every aneurism, so situated that the artery can neither be compressed, nor tied above the swelling, has generally been considered absolutely incurable, except by a natural process, the establishment of which is not sufficiently often the case to raise much expectation of a recovery on this principle. But it should be recollected, that sometimes the size of the swelling appears to leave no room for the application of a ligature above it, while things are in reality otherwise, in consequence of the communication between the sac and the artery bearing no proportion to the magnitude of the tumour itself. At the present day, also, enlightened by anatomical knowledge, and encouraged by successful experience, surgeons boldly follow the largest arteries, even within the boundaries of the chest and abdomen, as I shall presently relate; and numerous facts have now proved, that few external aneurisms are beyond the reach of modern surgery. It being certain, that aneurisms cannot be commonly cured, except by an obliteration of the affected artery, it follows, that the circulation must be carried on by the superior and inferior collateral branches, or else the limb would mortify. Experience proves, that the impediment to the passage of the blood through the diseased artery, obliges this fluid to pass through the collateral branches, which gradually acquire an increase of size. It is therefore a common notion, that it must be in favour of the success of the operation, if the disease be of a certain standing; and, in direct opposition to the sentiments of Kirkland, Boyer even asserts, that the most successful operations have been those performed on persons who have had the disease a long while. (*Maladies Chirurg.* t. ii. p. 116.)

There is this objection to delay, however, — the tumour becomes so large, and the effects of its pressure so extensive and injurious, that, after the artery is tied, great inflammation, suppuration, and sloughing, often attack the swelling itself, and the patient falls a victim to what would not have occurred, had the operation been performed sooner.

The large size of an aneurism, as Mr. Hodgson has rightly observed, is a circumstance, which materially prevents the establishment of a collateral circulation. When the tumour has acquired an immense bulk, it has probably destroyed the parts, in which some of the principal anastomosing branches are situated; or by its pressure it may prevent their dilatation. (*On the Diseases of Arteries and Veins*, p. 259.) The practice of permitting an aneurism to increase, that the collateral branches may become enlarged (says this gentleman), is not only unnecessary but injurious, inasmuch as the increase of the tumour must be attended with a destruction of the surrounding parts, which will render the cure of the disease more tedious and uncertain. (P. 266.)

The most successful operations which I have seen, were performed before the aneurismal swellings were large. However, notwithstanding the great disadvantages of letting the swelling become bulky before the operation, the fact has not always made due impression, and a few surgeons are yet blinded with the plausible scheme of giving time for the collateral vessels to enlarge. I remember a patient who had been advised to let the operation be postponed on such a ground, though the swelling in the ham was already as large as an egg.

Mr. Guthrie is of opinion, that the collateral branches begin to enlarge shortly after the commencement of the disease, as a part of the curative process, which nature, in most instances, endeavours to set up; "the essential points of which are, in an extremity.—1. The obliteration of the artery above and below the tumour. 2. The coagulation of the blood within it. 3. The enlargement of the collateral branches above and below it."

"It is necessary (he afterwards observes), that this enlargement of the collateral branches should take place, because, in many cases, the artery beyond or below the tumour is obliterated long before any operation is performed. The main supply of blood is already cut off from the extremity, and the operation adds very little to the derangement of the circulation which has already taken place below the tumour."

These facts appear to Mr. Guthrie to prove, what indeed cannot be doubted, that the collateral circulation is not in the same stage of preparation, in a limb whose main artery has been divided, as in one where an aneurism has existed for some time. They also explain why mortification is more common after wounded arteries, than after operations for aneurism. (See *Guthrie on Dis. of Arteries*, p. 139.)

In a case of wounded artery, I should say, that the greater tendency to mortification is likewise promoted by the following circumstances:—The common injection and distension of the cellular tissue with blood, the frequent simultaneous injuries of the collateral vessels and considerable veins, and sometimes of important nerves, the weakness often resulting from profuse external hemorrhage, and the depth and extent of the wound to various other textures.

Although Mr. Guthrie considers, that the doctrine of the power of the collateral vessels always to carry on the circulation in aneurism has been carried rather too far, and that the allowance of some little time for them to enlarge themselves for that purpose is useful; there may appear but a trivial difference between him and other surgeons, or, perhaps, none at all, when his belief is recollected, that such enlargement occurs in an early stage of the disease, and his precept is remembered, "that an aneurism should never be allowed to attain that size, which may render it injurious to the surrounding parts." (*Op.* cit. p. 140.) As I believe that the early editions of my surgical writings contain the first condemnation of the old plan of delaying the operation till the collateral vessels had had time to increase in size, this is a practical point in which I feel some interest; and the more I have seen and read of the present disease has only served to confirm the accuracy of the practical advice long ago delivered in my works on the advantages of early operations for aneurism.

The surgeon should not be afraid of operating, although appearances of gangrene may have taken place on the tumour; for, as Mr. Hodgson remarks, should it burst afterwards, it is probable, that both extremities of the artery in the sac will be closed with coagulum. (*Hodgson*, p. 305.) Sir Astley Cooper tied the external iliac artery in two cases of inguinal aneurism, when gangrene existed; and though the tumours burst, no hemorrhage ensued. The coagulum was discharged; the sac granulated; and the sores gradually healed. (*Medico-Chir. Trans.* vol. iv. p. 431.)

The effects of the pressure of aneurisms upon the bones, are justly regarded as an unpleasant complication, when they take place in an extensive degree, and, according to some writers, they may sometimes induce a necessity for amputation. (*Boyer, Traité des Mal. Chir.* t. ii. p. 117.) However, I have never seen a case of this description; and Mr. Hodgson, as we have already explained, informs us, that the affection of the bones is hardly ever attended with exfoliations, or the formation of pus, so that if the aneurism can be cured, the bones will generally recover their healthy state, without undergoing those processes which take place in the cure of caries, or necrosis. (*On Diseases of Arteries and Veins*, p. 80.) At the same time, there can be no doubt, that where the tumour has been allowed to attain a large size, before an attempt is made to cure it, and where, from this cause, both the neighbouring soft parts and the bones have suffered considerably, the completion of a cure — that is to say, the full restoration of the use of the limb — must be far more distant than in other cases, where the cure is attempted in an earlier stage. Here, then, we see another reason against the pernicious doctrine of waiting for the enlargement of the anastomosing vessels, in addition to that which has been urged in the previous column.

The age, constitution, and state of the patient's health, are also to be considered in the prognosis; for they undoubtedly make a great difference in the chance of success after the operation.

The operation, however, should not be rejected on account of the age of the patient, if the circumstances of the case in other respects appear to demand it; for it has often succeeded at very advanced periods of life. "I have seen several aneurisms cured by the modern operation, in patients above sixty years of age." (*Hodgson*,

p. 304.) Similar cases have fallen under my own notice. In cases of popliteal aneurism, Sir Astley Cooper operated with success on one patient aged eighty-five, and on another sixty-nine years old, with the same favourable result.

When an aneurism exists in the course of the aorta, the violent action of the heart, excited by an operation in the extremities, may cause it to burst, and prove instantaneously fatal. Two cases occurred a few years ago in this metropolis, in which the patients died from such a cause during operations for popliteal aneurisms. (See *Hodgson on Diseases of Arteries*, p. 306.; *London Med. Rev.* vol. ii. p. 246.; and *Burns on Diseases of the Heart*, p. 228.) Were the co-existence of the internal aneurism known, the operation for the other tumour would be improper, and the surgeon should limit the treatment to palliative means.

Experience proves, however, that the circumstance of there being two aneurisms in the limbs should not prevent the operation, which is to be practised at separate periods. Facts, in support of this statement, are quoted by Mr. Hodgson. (P. 310.)

An aneurism may form spontaneously, and yet the person may recover after an operation, without having a recurrence of the disease in any part. Mr. Guthrie knew a man who survived the operation for popliteal aneurism in both limbs for twenty-five years, and died at last of fever. (*On the Diseases and Injuries of Arteries*, p. 61. and 121.)

Of the spontaneous Cure, and general Treatment, of Aneurisms.

The obliteration of the sac, in consequence of a deposition of lamellated coagulum in its cavity, as Mr. Hodgson has well described, is the mode by which the spontaneous cure of aneurism is in most instances effected. The blood soon deposits upon the inner surface of the sac a stratum of coagulum; and successive depositions of the fibrous part of the blood by degrees lessen the cavity of the tumour. At length the sac becomes entirely filled with this substance, and the deposition of it generally continues in the artery on both sides of the sac as far as the giving off of the next large branches. The circulation through the vessel is thus prevented; the blood is conveyed by collateral channels; and another process is instituted, whereby the bulk of the tumour is removed. (*On the Diseases of Arteries, &c.* p. 114.) Such desirable increase of the coagulated blood in the sac is indicated by the tumour becoming more solid, and its pulsation weak, or ceasing altogether. In aneurisms of the limbs, the cure by coagulation is believed by Mr. Guthrie to be promoted by two natural processes, viz. the enlargement of the collateral branches, and the effort made to close or shut up the lower openings from the aneurism. He states, that in the Hunterian collection, there are several examples of all the openings into the aneurism, save the upper one, having been closed during life. It does not appear to him, however, that the coagulation of the whole of the blood in an aneurismal tumour is the necessary consequence of the closure of the lower opening; and unless this happens, the swelling will continue to increase. (See *Guthrie on Diseases of Arteries*, p. 90.)

Amongst Mr. Hodgson's plates may be seen one representing an aneurism of the femoral artery, or rather a dilatation of it, involving the whole of its circumference, and where the blood continued to pass through a narrow channel in the centre of the lamellated blood, nearly in its natural course. Had nature been allowed more time for the completion of her processes, what would have been the mode of cure? Probably the obstruction of the central channel by solid blood, the determination of the circulation to the collateral vessels, and then the gradual removal of the tumour by the absorbents. Whether a case, reported by Mr. Guthrie as one of an external aneurism, cured with the artery remaining pervious, is an unequivocal example of this occurrence, I cannot undertake to determine. (See *Guthrie on Diseases of the Arteries*, p. 100.)

Another mode, in which the disease is spontaneously cured, happens as follows: — An aneurism is sometimes deeply attacked with inflammation and gangrene; a dense, compact, bloody coagulum is formed within the vessel, shutting up its canal, and completely interrupting the course of the blood into the sac. Hence, the ensuing sphacelation, and the bursting of the integuments and aneurismal sac, are never accompanied by a fatal hemorrhage; and the patient is cured of the gangrene and aneurism, if he has strength sufficient to bear the derangement of the health necessarily attendant on so considerable an attack of inflammation and gangrene. I remember a femoral aneurism in the York Hospital, where a cure was accomplished in this manner. Mr. Guthrie has seen three cases of inguinal aneurism, attacked by inflammation and sloughing. (*On Diseases of Arteries*, p. 96.) One was the case under Mr. Albert, in the York Hospital, where the patient recovered: in the two others the patients died, worn out by the discharge and the extension of ulceration to the hip-joint; without which last complication, Mr. Guthrie deems it probable that both patients would have recovered — the ends of the artery, above and below the disease, having been obliterated.

When a patient dies of hemorrhage, after the mortification of an aneurism, it is because only a portion of the integuments and sac has sloughed, without the root of the aneurism, and especially the arterial trunk, being similarly affected. For cases illustrative of this statement, refer to *Hodgson on Diseaes of Arteries*, p. 103., &c.

All surgeons will concur with Mr. Guthrie, that the attempt at a cure by sphacelation is attended with so much peril, that, if possible, it should be prevented by a surgical operation. Yet, "*the operation should never be had recourse to after mortification* (that is to say, a deeply extending sphacelation) *has begun*. If the patient dies of the mortification, the operation is useless; and if he survives it, the operation is unnecessary." (See *Guthrie on Dis. of Arteries*, p. 98.) When the inflammation and sloughing are superficial and very limited, the operation would be indicated, because, unless the arteries were first taken up, the patient would die of hemorrhage on the slough being loosened.

A third way in which an aneurism may be spontaneously cured, is by the tumour compressing the artery above, so as to produce adhesion of its sides, and obliteration of this cavity. This mode of cure must be uncommon; it has been adverted to by Sir E. Home, Scarpa, Dr. John Thomson, and others; but some facts, tending to prove it, have been collected by Mr. Hodgson, and are published in his meritorious work. (See p. 107, &c.)

Rare as this mode of cure is, I do not coincide with Mr. Guthrie in looking upon this account as a mere theory (*Op.* cit. p. 98.); for we know by dissection, that the pressure of an aneurismal tumour upon the artery connected with it, may lead to the obliteration of the part or vessel pressed upon. Mr. Lawrence has mentioned in his lectures the particulars of a case, where the pressure of the sac of an aneurism in the groin, upon the artery lower down, had rendered the artery in this situation impervious.

A fourth mode of cure is illustrated in a case, related by Sir Astley Cooper: a man in Guy's Hospital, had an aneurism just below the groin. He was sitting before the fire, when he felt something burst in the upper part of his thigh. On examination, he found no blood had escaped, and, in fact, the aneurism had not yet reached the skin, so as to be adherent to it. His thigh, however, was enormously swelled; he was unable to use his limb, and was put to bed. For three days afterwards a pulsation was perceptible in the aneurism; but it then ceased, and the size of the limb began to diminish. At the end of four months, the aneurismal swelling had considerably subsided; he could use the limb; and in less than six months, he was discharged from the hospital. He afterwards fell a victim to the rupture of another aneurism in the abdomen. On examination of the body, it was found, that the aneurism in the thigh, just below Poupart's ligament, had burst under the fascia lata, and the femoral artery had been obliterated by the pressure of the large quantity of effused blood.

"The surgical treatment of aneurism (says Mr. Hodgson) consists in the obliteration of the cavity of the artery communicating with the sac, so that the ingress of the blood into the latter is either entirely prevented, or the stream which passes through it is supplied only by anastomosing branches, and consequently the force of the circulation is so much diminished, that the increase of the tumour is prevented, and the deposition of coagulum is promoted. By the absorption of its contents, and the gradual contraction of the sac, the cure is ultimately accomplished. The blood is conveyed to the parts, which it is destined to supply, by collateral vessels, some of which, being gradually enlarged, constitute permanent channels for the circulation. The obliteration of the artery is effected by the excitement of such a degree of inflammation in its coats, as shall produce adhesion of its sides. These objects have been attempted by the compression, or the ligature, of the artery. The latter method constitutes the operation for aneurism." (P. 165.)

Such are the principles of the ordinary mode of cure; but it appears, from certain facts recoeded by Mr. Wardrop, Dr. Bush, Dr. Mott, and other practitioners, that some aneurisms may be cured by a surgical operation, which was first suggested by Brasdor, or, according to Bichat, by Desault, and the design of which is to hinder the free transmission of blood through the aneurismal sac by tying the artery on that side of it which is most remote from the heart. This practice, however, is only allowable in certain examples, in which the application of a ligature in the common way is no longer practicable, because its success is much less probable, as might easily be anticipated, since the plan does not comprise the very desirable object of directly preventing the entrance of blood into the aneurismal sac. To this subject, however, we shall presently return.

According to Scarpa, *a complete cure of an aneurism cannot be effected, in whatever part of the body the tumour is situated, unless the artery, from which the aneurism is derived, be, by nature or art, obliterated, and converted into a perfectly solid, ligamentous substance, for a certain extent above and below the place of the ulceration, laceration, or wound.* When aneurisms are cured by compression, the cure is never accomplished, as some have supposed, by the pressure strengthening the dilated proper coats of the artery, and restoring, especially to the muscular coat, the power of propelling the blood along the tube of the artery, as it did previously to its *supposed dilatation.* Petit and Foubert thought, that the natural curative process sometimes consisted in a species of clot, which closed the laceration, ulceration, or wound of the artery, and resisted the impulse of the blood, so as still to preserve the continuity of the coats of the artery, and the pervious state of the vessel. Haller imbibed a similar sentiment, from experiments made on frogs.

If the foregoing statement of Scarpa, respecting the obliteration of the tube of the adjacent portion of the artery, when an aneurism is cured, had been delivered merely as what is the most common course of things, it would not have been incorrect; but when he denies the possibility of the calibre of the vessel being ever preserved, whether the disease be cured by art or nature, he is exceeding the bounds of accuracy.

Notwithstanding aneurisms cannot in general be cured, as Scarpa has explained, unless the artery be rendered impervious for some extent above and below the tumour, I believe we must make an exception to this observation, with respect to the few aneurisms of the aorta (especially those of its arch), which, according to the records of surgery, have been diminished and cured by Valsalva's treatment. In such examples, we are not to suppose that the aorta becomes obliterated at its very beginning; but that the diminution of the quantity of circulating blood, the reduced impetus of this fluid, the lessened distention of the aneurismal sac, the general weakness induced in the constitution, and the increased activity of the lymphatic system, — all necessary effects of Valsalva's method, — have combined to bring about a partial subsidence of the tumour.

"It is a common opinion (says Mr. Hodgson), that the radical cure of an aneurism cannot take place, without the obliteration of the artery from which the disease originates. It is probably owing to this idea, that aneurisms of the aorta have generally been considered as incurable diseases, and consequently that so little attention has been given to their treatment." (P. 118.) The facts, however, which this gentleman has related, satisfactorily prove — 1st, That a deposition of coagulum may take place in an aneurismal sac, to such an extent as entirely to block up the communication between its cavity and that of the artery from which it originates. 2dly, That a sac, thus filled with coagulum, cannot prove fatal by rupture; and, 3dly, That the gradual absorption of its contents, and the consequent contraction of the sac, may proceed to such an extent as to effect *the cure of the disease, without any obstruction taking place in the calibre of the vessel* from which it originates. (See cases 20, 21, 22, &c. *Hodgson on Diseases of the Arteries, &c.* p. 119, &c.) In support of this doctrine, some facts are also cited from Corvisart. (*Essai sur les Maladies du Cœur,* p. 313, &c.)

A part of these cases, it is true, are not viewed exactly in this light by Kreysig, who argues (as I think, without much probability), that they might have been only adipose swellings, connected with, or formed in, the parietes of the artery,—a disease described by Stenzel. (*German Transl. of Mr. Hodgson's book,* p. 174.)

Corvisart himself, instead of regarding such tumours as aneurisms *in the progress of cure,* conceived them to be aneurisms *in the course of formation;* and, on this point, Mr. Guthrie suspects that he was correct; because "the contents of the tumour were a substance of *less consistence than suet,* whilst, in all the cases of spontaneous cure, in which, from the history, the previous existence of aneurism was known, the contents have always been *firm,* or *very firm.* (*Guthrie on Dis. of Arteries,* p. 38.) But whatever may have been the nature of the swelling referred to by Corvisart, the fact of sacciform aneurisms of the aorta being sometimes entirely filled up by solid blood, and the disease cured on this principle, with the great channel of the aorta itself remaining pervious, is now universally acknowledged.

That a punctured artery may occasionally be healed, and still continue pervious, Scarpa himself proves, by a case which he examined, where an aneurism took place from the wound of a lancet in bleeding. In the article Hemorrhage, we shall see that Jones's experiments show the same thing, and the particular circumstances in which it may happen. But the occurrence is rare, and Scarpa says, that it can hardly be called a *radical* cure, as the cicatrix is always found in a state ready to burst and break, if the arm be, by any accident, violently stretched or struck where the wound was situated.

In the spontaneous cure of aneurisms, arising from arteries of inferior size to that of the aorta, repeated examinations have proved, that the deposition of coagulum does not merely fill up the sac, but obliterates the tube of the artery above and below the disease to the next important ramifications. Yet, even here, exceptions probably take place; for Mr. Hodgson has brought forward one instance, in which a small sac, which originated from the anterior artery of the cerebrum, was completely filled with firm coagulum, which did not extend into the cavity of the vessel. (*On Diseases of Arteries,* p. 132.) And he reports the particulars of a *true* femoral aneurism, communicated to him by Sir A. Cooper, in which, after the patient's death, the femoral artery was found dilated into a sac, which was lined on all sides with very firm layers of coagulum, in the centre of which was an irregular canal, through which the circulation was continued. As the inside of this canal presented a membranous appearance, it was inferred that the aneurism had been cured. (*Op. cit.* p. 134.) Here I may be permitted to remark, that, if this case be correctly reported, viz. if it were a true aneurism by dilatation of all the arterial coats, and the inside of it was *every where* lined by firm layers of coagulum, it amounts to a proof, that such a deposition is not entirely confined to aneurisms by rupture, as Scarpa supposes. And, in addition to this fact, I may mention, as referring to the same question, a case of aneurism from dilatation of the arterial coats, observed by Guattani, where the same process took place. "Arteriæ iliacæ ovalem hanc partem aneurysmaticam polyposa substantia variæ densitatis adeò infarctam esse denotebam, ut tunicarum ejusdem forma penitus destructa in uniformem massam, spongiæ cera imbutæ similem, transformata videretur." (Hist. xvii. *Collect. Lauth.* p. 158.)

Whenever the ulcerated, lacerated, or wounded artery is accurately compressed against a hard body, like the bones, it ceases to pour blood into the surrounding cellular sheath, because its sides, being kept in firm contact, for a certain extent above and below the breach of continuity, become united by the adhesive inflammation, and converted into a solid ligamentous cylinder. Molinelli, Guattani, and White give examples and plates illustrative of this fact. When aneurisms get well spontaneously, the same fact is observed after death, as Valsalva, Ford, &c. have demonstrated. I have myself seen, in St. Bartholomew's Hospital, an instance in which a man had had a spontaneous cure of an aneurism in the left axilla, but afterwards died of hemorrhage from another aneurismal swelling under the right clavicle: the artery on the left side was found completely impervious. Dr. Albert had under his care, in the York Hospital, Chelsea, a dragoon, who recovered spontaneously of a very large aneurism of the external iliac artery: the tumour sloughed, discharged about two quarts of coagulated blood, and then granulated, and finally healed up. Paoli relates a similar termination of a popliteal aneurism, and Moinichen and Guattani give other examples. Hunter found the femoral artery quite impervious, and obliterated, at the place where a ligature had been applied fifteen months before. Boyer noticed the same fact in a subject, eight years after the operation. Petit describes the spontaneous cure of an aneurism at the bifurcation of the right carotid: the subject having afterwards died of apoplexy, the vessel, on dissection, was found closed up and obliterated from the bifurcation, as far as the right subclavian artery. Desault had an opportunity of opening a patient, in whom a spontaneous cure of a popliteal aneurism was just beginning: he found a very hard, bloody thrombus, extending for three finger-breadths into the tube of the artery, above the sac, and so firm, that it resisted an injection, and made it pass into the collateral branches.

Both the spontaneous and surgical cures of aneurisms have generally two stages: in the first, the entrance of the blood into the aneurismal sac is interrupted; in the second, the parietes of the artery approach each other, and, becoming agglutinated, the vessel is converted into a solid cylinder. This doctrine is corroborated by the tumour first losing its pulsation, and then gradually diminishing and disappearing.

In order that compression may make the opposite sides of an artery unite, and thus produce a radical cure of an aneurism, Scarpa says, the degree of pressure must be such as to place these opposite sides in firm and complete contact, and such as to excite the adhesive inflammation in the coats of the artery. The point of compression must also fall above the laceration or wound of the artery; for when it operates below, it hastens the enlargement of the tumour: and Scarpa adds, that, in practice, bandages which are expulsive and compressive, are more useful for making pressure than any tourniquets or instruments, many of which are contrived to operate, without retarding the return of blood through the veins.

In order that pressure may succeed, the coats of the vessel, at the place where it is made, must be sufficiently free from disease to be susceptible of the adhesive inflammation. When the arterial coats, round the root of the aneurism, are much diseased, Scarpa considers them as insusceptible of the adhesive inflammation, although compressed together in the most scientific manner, and even when tied with a ligature, which only acts by making circular pressure on the vessel.

This statement would appear to derive confirmation from the following fact:—Mr. Langstaff amputated the thigh of a person seventy-five years of age; but the vessels were so ossified, that they could not be effectually tied, and the patient died within twenty-four hours. It is generally supposed, says Mr. Lawrence, that this condition of the arterial coats is incompatible with their union under the application of the ligature. The opinion should be received, however, with some limitation. In a man of fifty-nine years of age, bleeding took place nearly a month after amputation, from the ossified femoral artery, and Mr. Lawrence was therefore obliged to expose and tie that vessel again for the suppression of the hemorrhage; when he found a hard tube, which cracked immediately the ligature was tightened: the bleeding, however, never returned. (See *Med. Chir. Trans.* vol. vi. p. 193.) This case is mentioned, not with any view of encouraging surgeons to apply ligatures round diseased portions of arteries,—a thing which should always be avoided, when possible,—but to let them be aware that an ossified artery is sometimes susceptible of being permanently closed, when a ligature is put round it. With respect to Scarpa's idea of making pressure operate so as to place the two opposite parietes of the artery at the mouth of the aneurismal sac completely in contact, in order that they may be united by the adhesive inflammation, and the cavity of the vessel be obliterated, I should think with Mr. Hodgson, that if pressure will succeed only under these circumstances, it will answer very seldom; because, in almost all aneurismal sacs, a sufficient deposition of coagulum will have taken place to prevent the possibility of placing the opposite sides of the artery at the mouth of the aneurism in a state of complete contact. (*On Diseases of Arteries, &c.* p. 172.) Possibly, however, Scarpa's directions refer to a point of the vessel rather beyond the usual limits of the laminated coagula; and he is particular in recommending the practice only where the aneurism is soft and small.

Some advise trying compression in every case of aneurism, whether small, circumscribed, soft, flexible, indolent, or elevated, diffused, hard, and painful. But, in the latter case, Scarpa represents compression as decidedly hurtful. He says also, that every bandage which compresses the aneurism and also circularly constricts the affected part, is always injurious. The bandage, likewise, which compresses only the aneurism, and directs the point of pressure below the rupture in the vessel; that which, on account of the great size, exquisite sensibility, depth of the root of the aneurism, and fleshy state of the surrounding parts, cannot effectually compress the artery against the bones, so as to bring the opposite sides of the vessel into contact; and, lastly, the compression applied to a spontaneous aneurism, attended with a steatomatous, ulcerated, earthy disease of the arterial coats;—ought to be considered as more likely to do harm than benefit. In cases of a completely opposite description, bandages have produced, and may produce, a radical cure, and should not be entirely disused. (*Scarpa on Aneurism*, ed. 2. p. 221.)

Guattani first employed compression systematically for the cure of aneurisms; and out of fourteen cases in which he adopted the plan, four were cured by it. Be it remarked, that this distinguished surgeon applied, first charpie and compresses over the tumour, and then a roller, with only moderate tightness, from the lower part of the swelling to the upper part of the limb. The bandage, which was kept wet with an astringent refrigerent lotion was changed about once in three weeks. The patient was kept on a very low diet, perfectly quiet in bed, and a few general bleedings were practised. Mr. Freer details some other examples of success, and so does Lisfranc (*Op.* cit. p. 29.); but, in general, pressure has hitherto been applied to the tumour itself,—a method less likely to answer than that of making pressure on a sound part of the artery. Mr. Freer recommends the employment of Sennfio's instrument, or the following method:—First place a bandage, moderately tight, from one extremity of the limb to the other; then put a pad upon the artery a few inches above the tumour; next, surrounding the limb with a tourniquet, let the screw be fixed upon the pad, having previously secured the whole limb from the action of the instrument, by a piece of board, wider than the limb itself, by which means the artery only will be compressed, when the screw is tightened. The tourniquet should now be twisted till the pulsation in the tumour ceases. In a few hours the limb will become œdematous and swelled, when the tourniquet may be removed, and the pressure of a pad and roller will afterwards be enough. In experiments which this gentleman made on the radial arteries of horses, these vessels were found to become inflamed, and to be rendered impervious, by such a process. (*Freer*, p. 112.) Dubois is stated to have cured an aneurism of the thigh by steady pressure on the vessel for twenty-four hours. (*Med. Chir. Trans.* vol. iv. p. 437.)

Sir A. Cooper describes another machine for compressing the femoral artery, in cases of popliteal aneurism: it was used by Sir W. Blizard. —"The points of support for this instrument, were the outer part of the knee, and the great trochanter, a piece of steel passing from one to the other; and to the middle of this a semicircular piece of iron was fixed, which projected over the femoral artery, having a pad at its end, moved by a screw, by turning which, the artery was readily compressed, and the pulsation in the aneurism stopped, without any interruption to the circulation in the smaller vessels." But although the patient, on whom it was tried, possessed unusual fortitude, he was incapable of supporting the pressure of the instrument longer than nine hours. (*Med. and Phys. Journal*, vol. viii.) Mr. White, of the Westminster Hospital, tried pressure, by means of a newly invented spring, supposed to possess peculiar advantages. "The woman bore the pain heroically for five days, but the parts compressed sloughed deeply. The cure was completed; but (says Mr. Guthrie), the pain, danger, and risk incurred, were infinitely greater than any which could have been sustained from the usual operation." (*On Dis. of Arteries*, p. 142.) Few patients, indeed, can endure the pressure of such instruments a quarter of this time, when they are put on sufficiently tight to afford any chance of obliterating the artery; and, on account of the suffering which they produce, they are rarely used by modern surgeons.

When the treatment by pressure is attempted, the plan may be assisted with repeated bleedings, an exceedingly spare diet, and perfect quietude in bed. Digitalis has also been sometimes prescribed, with the view of lessening the impetus of the circulation. The superacetate of lead has often been tried on theoretical principles. Even at the present day, Mr. Guthrie recommends it, as a remedy, "which may possess the power of removing chronic inflammation of the coats of the arteries, and of inducing a return to a state of health. In the proportion of a grain of it to a quarter or half a grain of opium, he says, he has never seen it do any thing but good; and he has given it in much larger doses without any bad effect. (*On Dis. of Arteries*, p. 125.) I confess that my own confidence in the efficacy of the superacetate of lead in the cure of aneurism is much less, than that which has now been adverted to. It is likewise a favourite plan with some practitioners, to apply snow, or powdered ice, to the tumour, as I shall notice in describing Valsalva's treatment of aortic aneurisms. These last applications have been employed for the purpose of promoting the coagulation of the blood within the aneurismal sac, and the consequent obliteration of the cavity of the aneurism and the artery. Various examples, in which it produced a cure, are recorded by Guerin, Larrey, Sabatier, Pelletan, &c. (*Recueil Périod. de la Soc. de Santé de Paris*, No. 3. *Pelletan, Clinique Chir.*; and *Ribes, Bulletins de la Faculté de Méd. de Paris*, 1817. No. 1. and 2. p. 284.)

Lisfranc is acquainted with several cases, in which ice was tried, either alone, or in combination with general means and compression. The successes were nearly equal to the failures; so that, according to Lisfranc, experience ascribes a good deal of efficacy to this treatment. He refers, however, to some recent investigations made by M. Moulinié, principal surgeon of the Hôpital St. André, at Bordeaux, which give a very different view of the subject. (See *Lisfranc, Des diverses Méthodes pour l'Oblitération des Artères*, p. 25.) The latter surgeon is, on the whole, rather in favour of the practice: he observes, that in all the examples in the Bordeaux Hospital, the application of ice was not aided by other means; and that it was tried without discrimination. When an aneurism is free from pain, and is neither inflamed nor too large, he thinks that the plan can hardly produce any dangerous effects. In order not to occasion sloughing, he advises the use of ice to be suspended every two or three hours or oftener.

When the swelling is large, the parts very tense, their texture changed, and the skin thin, the practice is likely to accelerate the formation of a slough; and Breschet confirms a remark made by Mr. Hodgson, that some patients cannot continue this treatment beyond a few minutes, while others find it absolutely insupportable. (*Fr. Transl. of Mr. Hodgson's Work*, t. i. p. 212—229.) Galvanism was proposed a few years ago by M. Pravaz (see *Lisfranc, De l'Oblitération des Artères*, p. 34.), and by Mr. Benjamin Phillips (see *Experiments showing that Arteries may be obliterated without Ligature, Compression, or the Knife*, 8vo. 1833). Mr. Benjamin Phillips transfixed arteries with common sewing needles, with the view of exciting inflammation within them, and rendering them impervious. He proposes that the action of the needle may be assisted with galvanism. The extremely dense mass of albumen, which forms around the positive pole in using electro-puncture, seems to prove the rationality of this suggestion. MM. Pravez and Guerard punctured the aorta of a rabbit, and on bringing the galvanic conductors to the opening, a brownish clot was instantly formed, which suspended the hemorrhage for a time. However, as M. Lisfranc observes, the plan of electro-puncture, as a means of curing aneurism, in the absence of practical facts, can only be looked upon at present as an ingenious idea. (See *Lisfranc, Op.* cit. p. 34.)

The grand means, most to be depended upon, for curing aneurisms, is tying the artery above the tumour. This more certainly prevents the great ingress of blood into the sac, and, what is quite as important, more certainly excites adhesive inflammation within the tied part of the vessel, and, by holding the opposite sides of it steadily in contact, brings about their union and an obliteration of the tube of the vessel with tolerable regularity. The chief current of blood into the sac is thus stopped, the contents of the aneurism are afterwards gradually absorbed, and the tumour dwindles away in proportion. The natural course of the blood being now permanently interrupted in the arterial trunk, it passes more copiously into the collateral branches; and these enlarging and anastomosing with others, which originate from the large arteries beyond the obstruction, the necessary circulation is carried on. (See ANASTOMOSIS, and INOSCULATION.)

The ligature of the superficial femoral artery may be performed with the same confidence of success, as the ligature of the brachial artery; that is, without any fear of destroying the circulation, or depriving the subjacent limb of its vitality. Indeed, the numerous and conspicuous anastomoses, which are met with all round the knee, correspond exactly with those which are observed round the elbow, and at the bend of the arm. This is not a peculiarity of the arteries of the extremities; but it is a general rule which nature has followed in the distribution of all the arteries, that the superior trunks communicate with the inferior, by means of the lateral vessels. After the principal trunk of an artery is tied, its lateral branches not only carry on the circulation in the parts below the ligature, but do so with greater quickness and activity than they did previously, while the course of the blood was unimpeded through the principal trunk. This evidently arises from the increased propulsion of blood into the lateral vessels, as well as from the enlargement of the diameter of these vessels, After the amputation of the thigh, while the blood flows in a full stream from the superficial femoral artery, very little or no blood is poured out of the lateral vessels; but as soon as that artery is tied, the blood issues with impetuosity from the small arteries which run along within the vasti and cruræus muscles; and on these smaller arteries being also tied, the blood immediately oozes out from the minute arterial vessels of the muscles and cellular membrane. When the principal trunk of an artery is tied, its lateral branches gradually acquire a much larger diameter. After amputation of the thigh, on account of popliteal aneurism, the size and situation of which could not fail materially to impede the course of the blood through the trunk of the femoral artery, it has been often remarked, that, although both the trunk and the greater and smaller branches had been tied with the nicest accuracy, the patients have been in danger of losing their lives, on account of the repeated copious hemorrhages from the innumerable small lateral vessels that had become unusually enlarged. In several cases, during the treatment, and especially after the radical cure of popliteal aneurism, by tying the superficial femoral artery, in the upper third of the thigh, all the ramifications of the recurrent popliteal arteries have been felt beating strongly round the knee. In a man, who had been operated on for a popliteal aneurism, but a few years afterwards died from necrosis of the tibia, Boyer found the arterial branch, which runs in the substance of the sciatic nerve, equal in diameter to the radial artery. C. White, in dissecting the arm of a lady, who, fifteen years before, had been operated on for an aneurism in the bend of the arm, found the brachial artery obliterated, and converted into a solid cylinder, for three inches below the place of the ligature, and as far as the division into the radial and ulnar arteries; but the recurrent radial and ulnar branches had become so much enlarged, that, taken together, they exceeded the size of the brachial artery, above the situation of the ligature. In the dead body it is found, that an anatomical injection will pass more freely from one extremity to the other of an aneurismatic, than of a sound limb, and this even when no vessels are visibly enlarged. Although it be self-evident, that the circulation through the collateral vessels ought to be much more easy and quick, the lower down the ligature is applied to the principal trunk; yet experience shows, that this difference is not to be estimated very high; for in cases of popliteal aneurism, *cæteris paribus*, the success is the same, whether the femoral artery be tied low down or high up in the thigh. (*Scarpa.*)

This facility of the passage of the blood through the lateral vessels is not the same in subjects of all ages; and, in the same subject, it is not the same in the inferior, as in the superior extremity. An age under forty-five, and the operation being done in the arm, which is nearer the source of the circulation than the lower extremity, increase the chance of success. However, notwithstanding these are the opinions of Scarpa, and, as general ones, may not be incorrect, surgeons in England now operate for aneurisms of the lower extremity and on patients much older than forty-five, with a degree of confidence, which nothing but great success could inspire.

According to Scarpa, the circumstances chiefly preventive of success, especially in the popliteal and femoral aneurisms, are the following: rigidity, atony, or disorganization of the principal anastomoses, between the superior and inferior arteries of the ham and leg; sometimes depending on advanced age, or on it, *together with the large size of the aneurism, which, by long-continued pressure, has caused a great change in the neighbouring parts;* or sometimes on steatomatous, ulcerated, earthly, cartilaginous disorganization of the proper coats of the artery, not confined to the seat of the rupture, but extending a great way above and below the aneurism, and also to the principal popliteal recurrent arteries, tibial arteries, and, occasionally, to portions of the whole track of the superficial femoral artery. Sometimes, the pressure of a large aneurism renders the thigh-bone carious. In such circumstances, the ligature is apt to fail in closing the trunk of the artery; and, if it should succeed, the state of the anastomosing vessels will not admit of a sufficient quantity of blood being conveyed into the lower part of the limb. Hence, when the patient is much advanced in life, languid, and sickly; when the internal coat of the artery is rigid, and incapable of being united by a ligature; when the aneurism is of long standing, and considerable size, with caries of the os femoris, or tibia; when the leg is weak and cold, much swelled, heavy, and œdematous; — Scarpa considers the operation contra-indicated. I must, however, declare in this place, that I have seen large aneurisms, as well as aneurisms in persons of advanced age, cured by the Hunterian plan; and, with respect to the affection of the bones, though it may be an unfavourable circumstance, its consequences are generally less serious than those of ordinary caries.

It appears, then, that the obliteration of the artery, for a certain extent above and below the tumour, forms the primary indication in the radical cure of aneurism, whether compression or the ligature be employed: all other means are only auxiliary. Internal remedies may be useful, inasmuch as they tend to moderate the determination of the blood towards the place where the artery has been tied or compressed.

In the articles Hemorrhage and Ligature, I have described the effects of the ligature upon a tied artery, and particularly the various processes which arise from its application, and terminate in the permanent obliteration of the vessel. There, I have explained what are the best ligatures for use, as well as the safest manner of applying them. Confining myself at present to what expressly relates to aneurism, I shall merely annex the following general directions: —

First, The cord should be thin and round, such a ligature being most likely to effect a clean division of the internal and middle coats of the vessel, and not liable to produce extensive ulceration or sloughing. Lisfranc and others, who apprehend that a very thin silk ligature may make its way too rapidly through the external coat, prefer a strong round thread, or several united together, the flattened form being avoided. (*Lisfranc, Op.* cit. p. 52.)

Secondly, The ligature should be tight, in order to insure the complete division of the internal and middle coats, and to prevent its detachment; it being almost impossible, even with the thinnest ligature, entirely to cut through a healthy artery.

Thirdly, The vessel should be detached from its connections only to such an extent as is necessary for the passage of the ligature underneath it.

Fourthly, The immediate adhesion of the wound should be promoted by all such means, as are known to promote that process in general. (See *Hodgson on Dis. of Arteries*, p. 225, 226.)

Fifthly, The ligature should be applied, if possible, to a sound portion of the artery. When the artery is affected with atheromatous or calcareous depositions at the part where some method must be tried for its obliteration, M. Lisfranc rejects the ligature and prefers compressing, or plugging the vessel, or, at all events, some means which will not occasion so much risk as the ligature of rapidly dividing the artery. (*De l'Oblitération des Artères*, p. 64.) If we were compelled to tie a diseased portion of artery, the chance of secondary hemorrhage, I believe, would not be lessened by following M. Lisfranc's advice. It is right to state, however, that the plan of plugging an ossified artery was sometimes adopted by Baron Dupuytren and M. Roux, though probably not in cases of aneurism. According to M. Manec, they used as a plug a piece of bougie, and then applied a common ligature.

Sixthly, It should not be placed too near a collateral branch, which would prevent the formation of the internal clot, and the proeess of obliteration of the vessel would be likely to be interfered with.

In the course of his experiments upon brutes, to ascertain the operation of the ligature, Dr. Jones arrived at a fact, which offered the probability of leading to an improvement in the operation for aneurism. (*Treatise on Hemorrhage*, chap. iii.) When a small firm ligature is applied to an artery, it causes the division of the internal and middle coats; and if it be afterwards removed, an effusion of lymph takes place between the cut surfaces into the cavity of the vessel. *If several divisions of the internal and middle coats be thus effected in the vicinity of each other*, the effusion of lymph was found by Dr. Jones to be sufficiently extensive to obliterate the cavity of the vessel. Dr. Jones mentions *several divisions* as necessary; an important fact, which has generally been overlooked, and the application of one ligature supposed to be all that was specified. Indeed, several divisions of the inner coat constitute in reality the process introduced by M. Amussat, and termed by him *Des Mâchures*. In the year 1800, Mr. A. C. Hutchison tied the brachial arteries of two dogs, and removed the ligatures immediately after their application: in both instances, as he assures us, the complete obliteration of the canal of the artery was the consequence of the operation. (See *Pract. Obs. in Surgery*, p. 103.) If, immediately after the operation for aneurism, the ligature could be removed, and yet the vessel become obliterated, it would be highly advantageous, as there would then be left in the wound no extraneous substance to prevent its union, or promote secondary hemorrhage, by extending the sloughing, or ulcerative process, too far. It is to be regretted, that the repetition of the experiment by others has not been attended with success. Mr. Hodgson tried it, but the artery did not become impervious. (See *Experiments A. and B.*, p. 228, 229. of this gentleman's work.) Mr. Dalrymple of Norwich made the experiment not less than seven times on horses, and three times on sheep, and failed, in every instance, to obtain the same result as Dr. Jones. Not only was no coagulum formed, but even when the animal had been suffered to live until the thirteenth, fifteenth, and eighteenth days after the operation, the canal of the artery was not found obliterated. In each case, indeed, its calibre was contracted; but it was still capable of transmitting a lessened column of blood. (*Travers, in Med. Chir. Trans.* vol. iv. p. 442.) Thus, it appears that an effusion of lymph is an invariable consequence of the operation, and, as Mr. Travers has observed, the want of union is therefore owing to the opposite sides of the vessel not being retained in a state of contact, so as to allow of their adhesion. The presence of the ligature, in the common mode of its application, effects this object; and for the success of Dr. Jones's experiment, it appeared only necessary, that the opposite sides of the wounded vessel should be retained in contact, until their adhesion was sufficiently accomplished to resist the passage of the blood through the tube. This object might probably be effected by compression; but the inconveniences attending such a degree of pressure, as would retain the opposite sides of an artery in contact at the bottom of a recent wound, are too great to permit its employment. It occurred to Mr. Travers, that if a ligature were applied to an artery, and suffered to remain only a few hours, the adhesion of the wounded surfaces would be sufficiently accomplished to insure the obliteration of the canal; and by the removal of the ligature at this period, the inconveniences attending its stay would be obviated. The danger, produced by the residence of a ligature upon an artery, arises from the irritation, which, as a foreign body, it produces in its coats. Ulceration has never been observed to commence in less than twenty-four hours after the application of a ligature; whilst it is an ascertained fact, that lymph is in a favourable state for organization in less than six hours, in a wound the sides of which are preserved in contact. (*Jones*, chap. iv. exp. 1.) If it be sufficient, therefore, to insure their adhesion, that the wounded coats of an artery be kept in contact by a ligature only three or four hours, ulceration and sloughing may in a great degree be obviated by promoting the immediate adhesion of the wound. Justified by this reasoning, Mr. Travers performed several experiments, by which he ascertained, that if a ligature were kept six, two, or even one hour upon the carotid artery of a horse, and then removed, the adhesion was sufficiently advanced to effect the permanent obliteration of the canal. It appeared probable, that the same result would be obtained upon the healthy artery of a human subject. (See *Travers's Obs. in Med. Chir. Trans.* vol. iv.; and *Hodgson on the Diseases of Arteries and Veins*, p. 228. et seq.)

Sir Astley Cooper performed one operation for a popliteal aneurism, with the view of ascertaining the efficacy of such a method on the human subject. He completely stopped the flow of blood for thirty-two hours, and then removed the ligature; but the pulsations of the tumour commenced again. He next applied the ligature forty hours longer, at the end of which time no pulsation recurred on the ligature being taken away. On the twelfth day, however, a considerable bleeding took place, and it was necessary to take up the vessel anew.

Mr. A. C. Hutchison tried this method, as modified by Mr. Travers, in an operation, which he performed for a popliteal aneurism in a sailor, in Nov. 1813. A double ligature was passed under the femoral artery. The ligatures were tied with loops, or slip knots, about a quarter of an inch of the vessel being left undivided between them. All that now remained of the pulsation in the tumour, was a slight undulatory motion. Nearly six hours having elapsed from the application of the ligatures, the wound was carefully opened, and the ligatures untied and removed, without the slightest disturbance of the vessel. In less than half a minute afterwards, the artery became distended with blood, and the pulsations in the tumour were as strong as they had been before the operation. Mr. Hutchison then applied two fresh ligatures; hemorrhage afterwards came on; amputation was performed, and the patient died. (See *Practical Obs. in Surgery,* p. 102., &c.) Now, as Mr. Hutchison chose to apply other ligatures, on finding that the pulsation returned, the above case only proves that the artery is not obliterated in about six hours, and we are left in the dark respecting the grand question, namely, whether the vessel would have become obliterated by the effusion of coagulating lymph and the adhesive inflammation, notwithstanding the return of circulation through it. As for the hemorrhage which occurred, I think it might have been expected, considering the disturbance and irritation which the artery must have sustained in the proceedings absolutely necessary for the application of not less than four ligatures, and the removal of two of them. According to my ideas, only one ligature ought to have been used, and none of the artery detached. We also have no description of the sort of ligatures which were employed; an essential piece of information in forming a judgment of the merits of the preceding method. The application, removal, and reapplication of ligatures are not consistent with the wise principles inculcated by the late Dr. Jones; and have, in more instances than that recorded by my friend Mr. Hutchison, brought on ulceration of the artery, and hemorrhage.

The limits of this work prevent me from entering into the particulars of the interesting experiments, undertaken by Mr. Travers, upon the arteries of animals, for the purpose of ascertaining the earliest period when a ligature might be removed from an artery, without any risk of the vessel not being duly obliterated. A full detail of them may be seen in another work, (See *Med. Chir. Trans.* vol. iv. and vi.); and others, in relation to the same question, may likewise be perused in Scarpa's appendix to his great work on aneurism. (*Memoria sulla Legatura delle principali Arterie degli Arti, &c.* fol. Pavia, 1817). The cases above related, and other considerations, long ago satisfied me, that, flattering as the suggestion of Dr. Jones was, the plan of removing the ligature, previously to its natural separation, would never answer in the operation for the cure of aneurism, unless either an obliteration of the arterial tube would follow with reasonable certainty the taking away of the ligature directly after it had been applied and it had divided the inner coats of the vessel; or, at all events, unless the ligature could be withdrawn at a determinate period, when either the same obliteration would surely ensue, or be already complete; and all this, with such regularity and infallibility in every case, that the surgeon would have no chance of being called upon to apply another ligature, do a second operation, or disturb the artery in any kind of way whatsoever.

At length, in the prosecution of this inquiry, in which Mr. Travers evinced a full determination to be guided by no motive but the love of truth, he tried the temporary application of the ligature in a case of brachial aneurism, which was operated upon Feb. 14. 1817. The artery was tied an inch and a half above the bend of the elbow with a noose ligature, The pulsation in the radial artery immediately ceased. On the 16th, at four o'clock in the afternoon, the ligature was removed with little difficulty, after having remained on the artery *fifty hours.* No pulsation ensued in the vessel below the point, where the ligature had been applied, and the case was completely successful.

On the 28th November, 1817, in a case of popliteal aneurism, Mr. Travers tied the femoral artery at one o'clock. On the 29th, at four in the afternoon, the ligature was removed without difficulty, after having been on the vessel *twenty-seven hours.* At this period no pulsation could be felt in the sac; but, at seven in the evening, a faint pulsation was perceptible. On the 30th, the pulsation, though very distinct, was less strong than before the operation. On the 2d, 3d, and 6th of December, the pulsation is described as still continuing. On the latter day, pressure was applied, by means of a roller, from below the knee to the groin, and was continued for a month, during which time the pulsation in the sac evidently became more feeble. On the 10th of January, the tumour became tense, and severely painful, and no pulsation in it could be distinguished. The next day, the swelling was more diffused and less prominent; and on the 12th, as the disease underwent no amendment, Mr. Travers tied the artery again, about two inches above the place where the former ligature had been applied. The next day the pain had diminished. The ligature was afterwards allowed to separate of itself; and the case went on favourably to the cure. According to Mr. Travers, the first of these cases tends to prove, that *the continuance of the ligature upon the artery for a period of fifty hours,* as certainly and completely answers the purpose of its application, as if allowed to remain until thrown off by the natural process.

In the second case, Mr. Travers infers from the suspension of pain, and the diminished strength of the pulsation, for a month after the application of the temporary ligature, that a degree of impediment to the current of blood in the artery had been produced; circumstances, which once led him to entertain hopes, that the cure of the aneurism was gradually accomplishing. At length, however, the increase of the tumour, and the aggravation of pain, and inflammatory symptoms, dispelled such expectation, and it was thought necessary to tie the femoral artery a second time, and adopt the common mode.

There are one or two points about this case on which the author does not particularly dwell though they require consideration, ere one can form a correct judgment of the accuracy of one of his positions, "that non-pulsation of the sac is a sign auspicious, or otherwise, simply as it stands connected with increase or diminution of bulk, and pain." (*Med. Chir. Trans.* vol. ix. p. 415.) The first question is, how are we to account for the sudden accession of pain, the absence of pulsation, the increase of the swelling, and the other changes which happened on the 10th of January? Judging from the particulars given, I should say, that at this period, the aneurismal sac gave way, and the disease changed from the circumscribed into the diffused form; an alteration which would account for the pulsation being entirely lost, the increase of pain, and the extension of the swelling, &c. Now, although the circumstance of the sac giving way, or the increase of pain, swelling, &c. on the 10th of January, may be taken as an argument, that the application of the ligature for *twenty-seven hours* had failed in producing obstruction enough in the vessel to retard the progress of the disease, we ought to remember, that at the time when these changes happened, a trial of pressure was making, to which one might impute the change of the aneurism from the circumscribed to the diffused form, with quite as much probability, as to the enlargement of the sac by blood sent into it through the imperfectly obliterated artery. However this may be, certain it is, that the second operation was done, when no pulsation existed in the swelling; and, perhaps, therefore, the case would have been doubly interesting, had the artery not been tied a second time, until circumstances had unequivocally proved, that this cessation of pulsation, attended as it was with an inflammatory state of the tumour, would not ultimately have ended in the cure of the disease.

Here, however, I may be speaking rather in the spirit of an experimenter, whose curiosity has not been fully satisfied, than as a surgeon, who should always be governed by the paramount consideration of extricating his patient from danger; and this will appear the more likely, when I add, that my mind has long been made up about the inexpediency of the temporary ligature, as an innovation in surgery. The last case induced Mr. Travers to relinquish the temporary ligature; and, amongst other reflections, which incline him to give up the practice, he candidly states, "that the adhesive union is prevented by the enclosure of a foreign body in the wound, long before suppuration has commenced. Suppuration is as certain to take place, though the ligature be removed after a few hours, as if it were left to be cast off; and the granulating process is more languidly performed, after an interruption in its early stage, for the purpose of removing the obstacle to union, than where no such interruption has been given, and the obstacle has been removed by nature's own means. Hence, it follows, that the theory, which, in removing the ligature within a given time, proposed the double advantage of a quicker as well as a surer process, fails in both points, when brought to the test of practice upon the human subject." (See *Med. Chir. Trans.* vol. ix. p. 416, 417.)

We have seen, that when a temporary ligature, which had been applied to the brachial artery *fifty hours*, was withdrawn by Mr. Travers, pulsation in the aneurismal tumour at the bend of the elbow did not return, and the disease was cured; but, that, in another instance, where the ligature had been allowed to remain on the femoral artery only *twenty-seven hours*, a feeble pulsation was renewed a few hours afterwards in a popliteal aneurism, and as the swelling became painful and more diffused, some weeks after this experiment, though no pulsation could then be perceived, the femoral artery was tied a second time, and the ligature left to separate in the usual manner.

But, from a case more recently published, it would seem, that the employment of a temporary ligature for only *twenty-four hours* on the femoral artery, may obliterate the vessel, and accomplish the cure of a popliteal aneurism. The patient was a sea-faring man, aged thirty-two; and the operator, Mr. Roberts of Carnarvon; Mr. Evans and Mr. Carrey, other surgeons of that town being present at the application, and also at the removal of the ligature. No pulsation recurred in the tumour; the edges of the wound were brought together with adhesive plaster; and in eleven days the part was quite healed. (*Med. Chir. Trans.* vol. xi. p. 100.) This is the strongest case, I believe, which has been adduced in support of the use of the temporary ligature, whether we consider the little time which it was applied, the permanent cessation of all pulsation, the quickness with which the wound healed, or the complete recovery of the use of the limb; for when the patient was met six months after the operation, "he could go to the mast-head with as great facility as at any period of his life." This fact proves, also, that there is a degree of irregularity in the period when the temporary ligature may be removed, without the pulsation in the tumour below the constricted part ever returning. Whether the variety is to be referred to temperament, the kind of ligature used, its greater tightness in one case than another, or other circumstances, is not at present determined.

The greatest advocate, which this practice has gained, is Scarpa, whose sentiments, however, about the most advantageous form of ligatures, and mode of applying them in cases of aneurism, are at variance with what is inculcated by the best and most experienced surgeons in this country. Instead of using a fine ligature, composed of a single piece of thread, twine, or silk, he employs a cord consisting of from four to six threads, according to the size of the artery which is to be tied; and, instead of aiming expressly at the division of the internal coats of the vessel with his ligature, as the generality of English surgeons do, for reasons explained in another part of this work (see HEMORRHAGE), he prefers a largish ligature, and interposes, between the artery and the knot, a small cylinder of linen spread with ointment, with the view of preventing the inner coats of the vessel from being divided. His reasons for this practice may be explained in a few words: he admits, that whenever there is a concurrence of all the circumstances, capable of inducing, in the tied artery, the proper degree of adhesive inflammation, above and below the place where a single circular ligature has been applied, this method is adequate to produce a speedy and steady closure of the arterial tube. But, says he, it sometimes happens, at least in man, that the pressure made by the circular ligature produces the ulcerative process more quickly in the artery, than the adhesive inflammation. In fact, the circular ligature ulcerates the artery in general about the third day after the operation; and the adhesive inflammation does not always complete its course in this period of time. During this delay of the adhesive inflammation, the ulcerative process, occasioned by the pressure of the ligature, attacks more quickly even than surgeons generally suppose, the external cellular sheath of the artery, and penetrates into the cavity of the yet pervious vessel; and this, of course, with increased quickness, when the inner coats of the artery are already divided by the ligature. The dangers of non-adhesion and too rapid ulceration of the artery, Scarpa thinks, are placed at the greatest distance by preserving undivided all the three coats of the vessel under the pressure of the ligature; and hence his partiality to larger ligatures than are now used by the best surgeons in England, and to the interposition of a cylinder of linen between the knot and the vessel, as recommended by Paré, Heister, and Platner. If, however, he has had reason to suspect that a simple circular ligature has frequently failed in England, because other innovations have been occasionally substituted for it, and because *we should not have sought for a better, if we had already had the best,* how much more vulnerable is his own practice on a similar principle; since, generally speaking, it has not retained half so many approvers as they who still express their preference to other methods, and more especially to the use of a single ligature, uncomplicated with other extraneous substances! Is it probable, he asks, that the single circular ligature, which was formerly used with doubtful success by the greatest surgeons, should now have become, as is pretended, the most certain means of preventing secondary hemorrhage? "It is now wished (says he) to ascribe the failures of Mr. Hunter, and of many other operators, not to the circular ligature, but to the improper treatment of the wound in general, and in particular to the introduction into it of lint, and, more especially, to the irritation occasioned by the ligature of reserve." On the contrary, it is argued by Scarpa, that, though Mr, Hunter, after his first trials, simplified the local treatment, though all skilful surgeons merely covered the wound with a pledget of soft ointment, and most of them omitted the reserve-ligature, yet, notwithstanding these reforms, secondary hemorrhage, after the use of a simple circular ligature, was not rendered less frequent. (*On Aneurism,* p. 23. ed. 2.) With respect to the latter general assertion, its incorrectness may be learned by reference to the details of Mr. Hunter's own operations, and by going into the principal hospitals of this metropolis, where the use of a simple circular ligature for the cure of aneurisms rarely fails, so far as secondary hemorrhage is concerned. Why then did the operation more frequently fail here in former times? The answer is plain: the kind of ligature now employed in England cannot be compared to what was used in Mr. Hunter's time, or even to what was here in fashion forty years ago. And, besides the universal rejection of ligatures of reserve, practitioners now have a more thorough comprehension of what ought to be avoided in the operation, have a just fear of separating and disturbing the artery too much, know how to appreciate the advantage of closing the wound, and attach due importance to the choice of smaller or more eligible ligatures. (See HEMORRHAGE and LIGATURE.) When therefore, Scarpa supposed, that in England the practice with the circular ligature in the treatment of aneurism is materially the same now as heretofore, and that secondary hemorrhage is as frequent, he did not avail himself of all the information on the subject which he might have acquired from Mr. Wishart, the able translator of his writings on aneurism, or from an attentive perusal of Mr. Hodgson's valuable treatise.

In an equality of circumstances, conducive to the success of the Hunterian operation, Scarpa thinks that the fact is not proved, as it is presumed to be, that the rupture of the internal and middle coats of the artery does excite the adhesive inflammation and union of the artery more effectually, than is done by the simple compression and close contact of its two opposite internal parietes in a sound and uninjured state. This remark is partly true, and partly incorrect, at the same time that it involves a question, which must be deferred till we come to the article HEMORRHAGE. The truth in the observation is, that an artery may generally be rendered impervious with tolerable certainty, by compressing its opposite parietes steadily and firmly together for a certain time, without dividing its inner coats: the inaccuracy of it depends upon the fact, that surgeons have no instrument, nor contrivance (not excepting even the ligature of four or six threads, with the interposition of the cylinder of linen spread with ointment), which can retain the opposed undivided surfaces of the inner coats of the vessels closely together in the manner commended by Scarpa, and for the due time, without the objection of denuding more of the artery than need be done in the application of a small ligature; or without the serious inconvenience and risk necessarily attending the introduction of a larger quantity of extraneous matter into the wound than is desirable, with the view of averting all chance of the ulceration of the artery reaching beyond prudent limits. And, when metallic instruments are used for the same purpose, objections not less real are incurred, as will be hereafter more particularly explained.

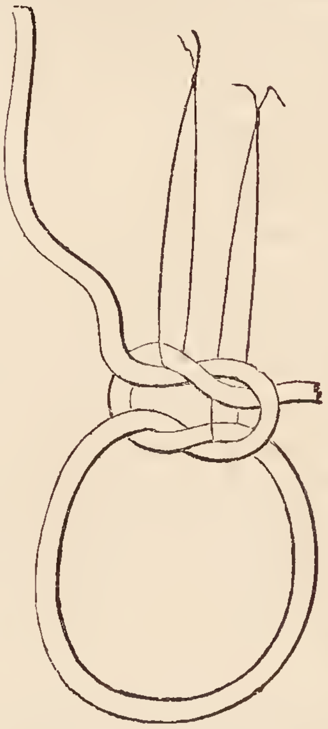
Scarpa considers, that his mode of ligature ought to be preferred, as combining the triple advantage of preserving entire all the three coats of the artery; of exciting quickly, and in a proper degree, the adhesive inflammation in them; and of retarding, as much as possible, the ulcerative process of the arterial tube.

Partly impressed, however, with the truth of the tenets laid down by Dr. Jones (see HEMORRHAGE), Scarpa enjoins attention to the following rules:—1. *Not to insulate and detach the artery any further than is necessary for allowing a ligature to be passed around it.* 2. Not to let the cylinder of linen exceed a line in length, or a little more above and below the breadth of the tape, which is about a line for the large arteries of the extremities. 3. That the ligature be not too tight. 4. And *that it be never applied immediately below the origin of a large lateral branch.* (See *Scarpa, On Aneurism,* p. 44. ed. 2.)

Some further consideration of Scarpa's mode of applying the ligature will be introduced in the article Hemorrhage; and I now proceed to notice his sentiments concerning the advantage which may be derived from removing the ligature in cases of aneurism, as soon as the tube of the vessel has been obliterated by the adhesive inflammation. From the facts recorded by Scarpa, it is inferred, that, with the kind of ligature and the cylinder of linen used in his practice, the closure of the artery by the adhesive inflammation and the two internal coagula is sufficiently far advanced *on the third or fourth day after the operation,* to resist the impulse of the blood; and hence (says he) there is no rational motive for waiting beyond this time for the spontaneous separation of the ligature, or for allowing it, by its further presence, to ulcerate, and even open the artery at the principal point of adhesion. He then comments on the advantages to the wound, derived from the removal of all extraneous matter from it on the third or fourth day. With respect to the general opinion of such removal, however, he makes one exception, viz. the case of great and evident debility from sickly constitution, or very advanced age, as it is observed that, in such patients the reunion of a simple wound is frequently protracted to the sixth day. *In cases of this description, Scarpa recommends delaying the removal of the ligature to the completion of the fifth, or sixth day,* but under the express condition, that the ligature has been applied with the interposition of a cylinder of linen; as it is proved that a common circular ligature causes ulceration of the artery before the third day, and it is not till the sixth day that the external coat of the vessel begins to ulcerate, when the other modification of the ligature is adopted. (P. 50.)

Scarpa supports the preceding advice by four cases, in which his kind of ligature was applied, and withdrawn at the end of the third, or fourth day, and the arterial tube obliterated. However, I do not think that, in England, these cases, when minutely and attentively considered, will be regarded as inducements to persevere in the use of temporary ligatures. In every instance the wound is described as suppurating, and sometimes *plentifully.* In one, the foot mortified, and amputation became necessary. In another, the very day after the disturbance of removing the ligature, the thigh was attacked with erysipelas, and, on the eighth day, the wound is represented as being *foul,* and the erysipelas not yet cured. It is but fair to add, that M. Roux seems to have operated on Scarpa's plan with results much more encouraging; for he is stated to have taken up the principal arteries of the neck and limbs in this way nearly fifty times, and lost but five or six of the patients from hemorrhage or sphacelus. (See *Lisfranc, de l'Oblitération des Artères,* p. 71.)

Independently of the uncertainty of the period, when the arterial tube is closed by the adhesive inflammation in various patients, it appears to me that the disturbance of the vessel and wound, by the steps necessary for the loosening and removal of the ligature, will ever form an inseparable objection to the practice. Scarpa appears to have some apprehension of this kind himself; for he remarks, "In the act of removing the ligature, there can be no doubt it is of great consequence that the artery be not rudely handled, or stretched. And, indeed, if, on untying the running knot, the subjacent knot could be with the same facility untied, we could not wish for a better mode of performing this part of the operation. But, the knot, although a simple one, is not so readily untied as the running knot, on account of the moisture, with which the threads forming the ligature are soaked, or because the ligature has been previously waxed." (P. 64. ed. 2.) In fact, his apprehensions then lead him to suggest the scheme of placing, previously to making the knot, a thread longitudinally, on each side of the cylinder; and, at the time of removing the ligature, the threads are to be drawn in opposite directions, in order to undo the knot, without displacing or stretching the artery. This reminds me of the ingenious contrivance of Mr. John Barker of Ipswich, whereby the ligature, at any period judged advisable, is removed without any disturbance of the wound: it is rendered perfectly intelligible by the annexed diagram.



Instead of one small ligature, which is all that an English surgeon leaves in the wound, Scarpa recommends his ligature of four or six threads, a roll of linen, and two other threads; a quantity of extraneous substances, which cannot fail to be a source of serious irritation and mischief. I shall therefore take leave of the proposal of removing the ligature on the third or fourth day, or any other particular day, with expressing my belief, that, if there were only the following objection to the plan, it would never be adopted in this country; namely, all the advocates for this practice, excepting Mr. John Barker, whose plan has considerable merit, renounce the infinite advantage of bringing the edges of the wound together directly after the operation. Had the suggestion of Dr. Jones proved invariably correct, and the ligature admitted of being withdrawn immediately after the inner coats of the vessel had been divided by it, the case would have been very different, as there would then have been no foreign body at all left in the wound; the parts might have been immediately brought together with the greatest chance of union by the first intention, and no subsequent disturbance either of the artery, or of the wound, would have been incurred. At the same time, I admit, that if the removal of the ligature at the end of a given time should ever prove the best practice, then Mr. Barker's ingenious contrivance for undoing and extracting the ligature without any irritation of the parts, or keeping the wound open for the purpose, may become a proposal of great practical importance. At present, I am decidedly of opinion, that it is best to leave the ligature till it becomes loosened, which usually happens between the tenth and twentieth days after the operation. (See *Lisfranc, de l'Oblitération des Artèries,* p. 63.)

The next practice which I shall notice, is that of applying two ligatures to the artery, and cutting it through in the interspace. This suggestion may be said to be as ancient as the time of Celsus, who advised the method to be followed in the treatment of a wounded artery. (*De Medicinâ*, lib. v. c. 26. § 21.) The fact is curious, though I mention it without the least intention of detracting from the great merits of several modern surgeons, that the Greeks were acquainted with the practice of tying the artery with two ligatures, and dividing it between them, high above the tumour, as will appear by a reference to Ætius. (4 Serm. tetr. 4. cap. x.). In the same ancient work, we are directed to open the aneurismal tumour at the bend of the elbow, and when the blood has been evacuated, to tie the artery twice, and divide it.

This method of applying two ligatures to the artery, and dividing the vessel between them, a method spoken of by Ætius, was revived in France about sixty years ago by Tenon, who, as well as some later surgeons, was totally unacquainted with its antiquity. (See *Pelletan, Clinique Chir.* t. 1. p. 192.) At one time, it had also modern advocates in Abernethy and Maunoir, each of whom supposed the plan an invention of his own. (See *Surgical and Physiol. Essays*, part iii. 8vo. Lond. 1797; and *Mémoires Physiologiques et Pratiques sur l'Aneurisme, &c.* 8vo. Genève, 1802.) Some of its advocates suspected that too rapid an ulceration of the artery and secondary hemorrhage, arose from the traction exercised in opposite directions by the upper and lower portion of the vessel; and they conceived that each end of the divided artery formed a circular prominence beyond the ligature, calculated to hinder it from slipping. Hence, according to their view, the less frequency of secondary hemorrhage after amputations, than after operations for aneurism.

When an artery is laid bare, and detached from its natural connections, and the middle of such detached portion tied with a single ligature, as was John Hunter's practice, Abernethy conceived that the vessel, so circumstanced, would necessarily inflame, and be likely to ulcerate. The occurrence of bleeding from this cause at first led to a practice, which this gentleman justly censures, viz. applying a second ligature above the first, and leaving it loose, but ready to be tightened in case of hemorrhage. As the second ligature, however, must keep a certain portion of the artery separated from the surrounding parts, and must, as an extraneous substance, irritate the inflamed vessel, it must make its ulceration still more apt to follow. The great object, therefore, which Abernethy insisted upon, was that of applying the ligature close to that part of the artery which lies amongst its natural connections: a just principle, the truth and utility of which still remain incontrovertible, though there may be a better way of accomplishing what Abernethy intended, than the measures which he was led to recommend.

The peculiarity in Abernethy's first operation consisted in applying two ligatures round the artery, close to where it was surrounded with its natural connections. For this purpose, he passed two ligatures of middling size beneath the femoral artery; and having drawn one upwards, the other downwards, as far as the vessel was detached, both the ligatures were firmly tied. The event of this case was successful. An uneasy sensation of tightness, however, extending from the wound down to the knee, and continuing for many days after the operation, made Abernethy determine, in any future case, to divide the artery between the two ligatures, so as to leave it quite lax.

Abernethy next relates the particulars of a popliteal aneurism, for which Sir Charles Blicke operated, and divided the artery between the ligatures. The man did not experience the above kind of uneasiness; and no hemorrhage ensued when the ligatures came away, although there was reason to think that the whole arterial system had a tendency to aneurism, as there was also another tumour of this kind in the opposite thigh.

The reasoning which induced Abernethy to revive this ancient practice was ingenious; for, when the artery was tied with two ligatures, and divided, in the foregoing manner, it was argued that it would be quite lax, possess its natural attachments, and be as nearly as possible in the same circumstances as a tied artery upon the face of a stump. Strictly speaking, however, as Mr. Hodgson first pointed out, an artery tied in two places, and divided in the interspace, cannot be regarded as placed exactly in the same condition as an artery tied in amputation. In the latter case, the retraction of the vessel corresponds with that of the surrounding parts, which are divided at the same instant, and therefore its relative connections stand as before the operation. But, in the operation for aneurism, the retraction of the artery takes place without being attended with a corresponding retraction of its connections. How far the retraction of the artery is beneficial, or injurious, is by no means evident; and the advantages arising from it, may, in most situations, be obtained without dividing the vessel, by placing the limb in a bent position. One important objection, however, is gained by the division of the artery; namely, that it is generally in that case tied close to its connections, and it is very evident how liable the application of the ligature in the middle of a denuded extensive portion of the vessel must be to produce ulceration or sloughing of its coats. The same object, however, will be gained by tying the undivided artery close to its connections at the end nearest to the heart; and the existence of a single ligature at the bottom of the wound will be less liable to give rise to suppuration and the formation of sinuses, than the employment of two. When an artery is divided, the portions situated beyond the ligatures must slough, and prove an additional cause of suppuration in the wound. Experience has amply proved the safety of employing a single ligature, and it is at present used by many of the most experienced operators in this country. (See *Hodgson, On the Diseases of Arteries, &c.* p. 221, &c.

According to Scarpa, numerous examples of the failure of the plan of applying two ligatures, and cutting through the artery in the interspace, are already generally known. He speaks of one failure, which occurred to Abernethy himself. But I entertain doubts how far any inference against the method can be drawn from Monteggia's instance, in which a ligature of reserve was used. Nor can I understand how a circumstance, which Scarpa strongly insists upon, can be well founded; I mean, the danger of the ligature being forced off the mouth of the artery by the impulse of the blood. Any risk of this kind cannot exist if the ligature be duly applied, as Dr. Jones has particularly explained; and, at all events, how can it be greater here than after amputation, where it is not usually made a subject of complaint? Indeed, the several examples of secondary hemorrhage, after this method, quoted by Scarpa from the practice of Monteggia, Morigi, and Assalini, may be more rationally imputed either to reserve-ligatures having been also used, or the common fear in Italy of applying the ligatures tightly; in which event, one can readily suppose that the ligature might really slip, or, by remaining a long time on the vessel, give rise to dangerous ulceration. Thus, Morigi speaks of one case, in which the bleeding occurred on the *nineteenth day.* (*Scarpa, On Aneurism*, p. 14. ed. 2.) On the whole, I am disposed to believe, that when this method has been executed precisely according to Abernethy's directions, it has not often failed; and I am acquainted with only one case in London, in which it was followed by secondary hemorrhage. However, in the year 1807, Mr. Norman of Bath, tied the femoral artery with two ligatures, and divided the vessel between them; the upper ligature came away on the sixteenth day after the operation; the lower one on the fifteenth; and the following day a profuse hemorrhage came on, the patient losing a pound of blood. Pressure with a compress and wet bandage was continued for some time, and the wound healed. (See *Med. Chir. Trans.*, vol. x. p. 123.) This is the only case of secondary hemorrhage, which Mr. Norman has met with after operating for aneurisms.

Scarpa very properly remarks, that the application of two ligatures, and dividing the artery in the interspace, can never be an eligible mode, where the smallness of the space, the depth of the artery, and the importance of the surrounding parts do not permit the vessel to be separated and insulated to such an extent as is required for dividing it, with a probability of the division of it being sufficiently distant from the two ligatures. Such, for example, are the cases of ligature of the carotid in the vicinity of the sternum; of the iliac above Poupert's ligament; of the internal iliac, a little below its origin from the common iliac; of the axillary artery between the point of the coracoid process and the acromial portion of the clavicle; or of the subclavian in its passage between the scaleni muscles. Scarpa then comments on the difficulty, and even impossibility, of taking up the end of the truncated artery again in many situations, were hemorrhage to ensue; and he joins Mr. Hodgson in thinking the advantages of the method, even where it is practicable, by no means demonstrated. Nay, he goes further; for he agrees with Heister, Callisen, and Richter in setting it down as worse than useless, on account of the portion of the artery between the ligatures being converted into a dead and putrid substance, which rests upon the bottom of the wound, from which it cannot be removed, until the two ligatures are separated. Here, deeply impressed with the truth of principles, which perhaps he has rather lost sight of in speaking of his own particular method, he comments on the little probability of the wound uniting, under the disadvantage of two ligatures hanging out of it, and of sloughs at its bottom. He argues correctly, that the laying bare, and insulating a large portion of artery, would often be objectionable on the ground, that it could not be done without the surgeon being obliged to apply the principal ligature too near the origin of a large lateral branch; as would happen in a case of inguinal aneurism, situated *an inch and a quarter* below the origin of the profunda. Thus, a coagulum could not be formed, and the artery would be in danger of not being closed. On the contrary, by employing only a single ligature, at *an inch and a quarter* below the origin of the profunda, the operation would be simple and successful. (*Scarpa, On Aneurism*, p. 19—21. ed. 2.)

The above considerations would certainly lead me to avoid the practice of detaching an artery from its surrounding connections any more than is absolutely necessary for the conveyance of a single ligature under it; but I fully concur with Sir Astley Cooper, in the prudence of using two ligatures, and applying them in the way recommended by Mr. Abernethy, whenever the artery has been extensively separated from its sheath in the operation.

The frequent occurrence of accidents after the introduction of Mr. Hunter's operation might have been ascribed to more probable causes than the condition of an undivided artery, upon which the ligature was applied. The employment of numerous ligatures gradually tightened, or the introduction of extraneous bodies into the wound, were alone sufficient to produce ulceration of the artery: and such practices were adopted in most of the cases, in which secondary hemorrhage took place.

After the reasons, which have been specified against the plan of tying the artery with two ligatures, and dividing it in the interspace, it may appear superfluous to notice a modification of this practice, intended as a security against the slipping of the ligature. But, as the proposal has had the approbation of some men of eminence, the subject may still be worthy of notice.

Sir Astley Cooper published a case of popliteal aneurism, in which the femoral artery had been tied with two ligatures, as firmly as could be done without risk of cutting it through. "But (says he) as I was proceeding to dress the wound, I saw a stream of blood issuing from the artery, and when the blood was sponged away, one of the ligatures was found detached from the vessel. Soon after, the other was also forced off; and thus the divided femoral artery was left without a ligature, and unless immediate assistance had been offered him, the patient must have perished from hemorrhage." The same kind of accident occurred in Mr. Cline's practice. For the prevention of it, Sir Astley at first tried the method of conveying the ligatures, by means of two blunt needles, under the artery, an inch asunder, and close to the coats of the vessel, excluding the vein and nerve, but passing the threads through the cellular membrane surrounding the artery. When these were tied, and the artery had been divided between them, the ligatures were prevented from slipping by the cellular membrane through which they passed. Afterwards, however, he tried a different mode of securing the ligature, suggested to him by Mr. H. Cline. "An incision being made on the middle of the inner part of the thigh, and the femoral artery exposed, the artery was separated from the vein and nerve, and all the surrounding parts, to the extent of an inch; an eye-probe, armed with a double ligature, having a curved needle at each end, was conveyed under the artery, and the probe cut away. The ligature nearest the groin was first tied; the other was separated an inch from the first, and also tied. Then the needles were passed through the coats of the artery, close to the ligatures between them, and the ends of each thread were again tied over the knots made in fastening the first circular application of the ligatures. Thus, a barrier was formed, beyond which the ligature could not pass." This operation was successful. (*Med. and Phys. Journ.* vol. viii.) A similar proposal appears to have been mentioned by Dionis, and some subsequent writers, especially by Richter, in the 13th chapter of his *Anfangsgründe der Wundarzneykunst,* b. i. ed. 3. 1799.

Where ligatures slip off directly after their application, I conclude that the arteries either cannot have been tied with sufficient tightness, or else that the noose becomes slack, from causes which will be understood by considering what is said on this matter in the article HEMORRHAGE. The inner coats of the artery, we know from the experiments of Dr. Jones, ought to be cut through when the artery is properly tied, because the circumstance is always useful in promoting the effusion of lymph within the vessel, and the process of obliteration by the adhesive inflammation: it may also be advantageous in keeping the ligature from slipping.

The preceding method is so contrary to the grand principle of always avoiding the detachment of the artery from its surrounding connections, and is so inconsistent with the wise maxim of completing the operation with as little disturbance of the vessel as possible, that it is not surprising that it should have met with only a small number of followers. In fact, it is not only liable to every objection which can be urged against the double ligature and division of the artery, as formerly proposed by Celsus, and a few of the moderns, but, on account of its greater tediousness, more extensive separation and destruction of the vessel, and other reasons, is still less worthy of imitation.

With respect to ligatures of reserve, the interposition of agaric, cork, and other hard substances between the knot and the artery, these contrivances are now so fully rejected by all good surgeons, for reasons which will be quite intelligible after the perusal of another part of this work (see HEMORRHAGE), that I shall not at present detain the reader with animadversions on their danger. As for several kinds of metallic compressors intended to be applied to the exposed artery, for the purpose of rendering it impervious, they are inventions which have been made and extolled by some surgeons of high repute, whose names would give importance even to a less meritorious proposition.

Dubois conceived that hemorrhage might sometimes proceed from the circumstance of a ligature making its way too fast through the artery. He thought, also, that the sudden stoppage of the current of blood by a tight ligature might bring on gangrene of the limb, particularly when the aneurism was not of long standing, so that the collateral branches had not had time to enlarge. Dubois, therefore, proposed, a method of *gradually* stopping the flow of blood through the artery; and by this ingenious imitation of the process of nature, to promote the gradual dilatation of the collateral arteries, and obviate all risk of gangrene in the lower part of the limb. This gentleman put his plan in execution, and two instances of success are recorded. The cases were popliteal aneurisms. A ligature was passed under the artery in the manner of Hunter; its two ends were then put through an instrument called a serre-nœud, with which the compression was gradually increased. It is stated, that, in one of these cases, the plan made the artery inflame and become impervious, in the course of the first night, so that on the following day the throbbing of the tumour had ceased. (*Richerand, Nosogr. Chir.* t. iv. p. 109. edit. 4.) Here, however, it is to be suspected, that the pressure of the apparatus was greater than was calculated; and that the stoppage of the pulsation was more owing either to this cause, or to the coagulation of the blood, in the sac and adjoining portion of the artery, than to the process of obliteration, which could hardly have been so rapidly accomplished.

Assalini's compressor is an instrument, calculated, as its inventor states, to produce an obliteration of the trunks of arteries, without dividing or injuring their coats. It is nothing more than a small pair of silver forceps, the blades of which are broad and flat at their extremities, between which the artery is compressed. A spring, composed of a piece of elastic steel, is attached to the inside of one of the handles, and, by pressing against the opposite handle, retains the flat ends of the blades in contact. This spring is intended to be very weak in its operation; but, by means of a screw which passes through the handles, the pressure admits of being regulated and increased at the option of the surgeon.

A representation of Assalini's compressor may be seen in his *Manuale di Chirurgia, parte primâ,* p. 113. In the same book, or in my friend Mr. Hodgson's valuable *Treatise on the Diseases of Arteries and Veins,* which every practical surgeon ought to possess, a case may be perused, in which this instrument was successfully employed by Professor Monteggia, and withdrawn entirely, as early as sixty hours after its application. This last distinguished surgeon also used the compressor in an example, in which the femoral artery was wounded, and bled in an alarming degree. After forty hours, the pressure was lessened; and, in four hours more, as not a drop of blood issued from the vessel, and there seemed to be no good in leaving an extraneous body in the wound any longer, the instrument was taken out altogether. (See *Assalini's Manuale di Chirurgia* p. 110.)

When Assalini was in England, he acquainted Mr. Hodgson, that in two cases of popliteal aneurism, in which he had himself employed this means of obliterating the femoral artery, the instrument was removed at the expiration of twenty-four hours; no pulsation returned in the tumours; and the patients were speedily cured.

With respect to the particular merit of this invention, it certainly possesses the recommendation of ingenuity; but it operates much in the same manner as several other mechanical contrivances of the *serre-nœud* of Dessault, the *presse-artère* of Deschamps, that of Mr. Crampton (see *Med. Chir. Trans.* vol. vii.), the pincers of Baron Percy, &c. If there be a real advantage in the division of the internal coats of an artery by the ligature, as the experiments of Jones seem to prove, and as many of the best surgeons in this country inculcate (see HEMORRHAGE and LIGATURE) then the compressor cannot be an eligible means of obliterating an artery. It may be said, however, that experience has proved its efficacy; but, let it be recollected that almost every method of operating upon aneurisms has sometimes answered. Further experience is requisite to determine whether Assalini's compressor would succeed as often as, or more frequently than, the scientific application of the right kind of ligatures (see LIGATURE), which may perhaps seem slower in their effect, only because they are not in general removed as early as Assalini's instrument. In fact, the experiments of Mr. Travers have now proved, that the ligature is the quickest in its operation. (See *Med. Chir. Trans.* vol. vi. p. 643., &c.)

In 1816, some ingenious observations were published by Mr. Crampton, on the effects of the ligature and of compression in obliterating arteries. The purport of his remarks is to prove, like the later observations of Scarpa: 1st, That the obliteration of an artery can *very certainly* be effected, independently of the rupture or division of any of its coats; 2dly, That this operation of the ligature, so far from being essential to the process, not unfrequently defeats it. (See *Med. Chir. Trans.* vol. vii. p. 344, 345.)

With respect to the first of these assertions, I presume, that all practical surgeons have known and admitted it, especially if the words *very certainly* be left out. Every system of surgery, for half a century past, has recorded the occasional cure of aneurism by different modes of compression, by which the adhesive inflammation is excited in the artery, or the coagulation of the blood in the aneurismal sac brought about. As, however, the most experienced surgeons have found the method less certain than the use of the ligature, it is not represented, by any modern writers, as deserving equal confidence; though they are circumstances in which simple pressure may be sometimes tried, with the hope of doing away all occasion for an operation. The cases, however, in which compression is applied directly to the artery itself by means of ligatures, with the intervention of other substances, as advised by Scarpa, &c., or by various contrivances, like those of the serre-nœud, the presse-artère, and Assalini's forceps, all require the exposure of the artery; and if commendable, therefore, cannot be so on the principle of saving the patient the pain of an operation, but because they are more effectual than the employment of the ligature. This last point remains to be proved. From the comparatively small number of instances, in which the preceding modes of compression have been practised, several examples of failure might be quoted.

With regard to Mr. Crampton's second assertion, that the division of the inner coats of the vessel, so far from being essential to the process of obliteration, not unfrequently defeats it, I think the last part of the observation is altogether unproved. We must admit, that the division of the inner coats is not essential, because arteries sometimes become obliterated under a variety of circumstances in which such division is not made; but still, the great question remains, whether it renders the process more certain. Mr. Crampton founds his conclusions, that it not unfrequently prevents the obliteration, and gives rise to secondary hemorrhage, upon a few very uncommon cases in which aneurismal swellings have taken place above the ligature. (See *Warner's Case,* p. 119. *of this Dictionary.*) Here Mr. Crampton presumes that the occurrence happened from the division of the inner coats of the artery, though Warner himself suspected, with more probability, that it proceeded from a diseased state of the vessel. Besides, this event, be it produced in whatever manner it may, is so rare, that I only know of three examples of it on record, and have never known it occur during the many years that I have been in the constant habit of seeing numerous operations performed. In Warner's time, also, the ligatures used were so thick, that they must have been more likely just to press the sides of the artery together, like Mr. Crampton's *presse-artàre,* than effect a complete division of the inner coats of the vessel, as is accomplished by the small ligatures in modern use.

Those metallic instruments, intended to be applied directly to an exposed artery, for the purpose of obliterating it by compression, are liable as Scarpa remarks, to all the inconveniences which are inseparable from the presence of hard bodies, introduced and kept for several days in the bottom of a wound; especially when this is recent, in which case they cannot be retained in a proper direction without difficulty, or exactly at such a depth as will not be attended with hurtful pressure upon the wound itself, and important parts in its vicinity. And, with regard to the forceps of Assalini, Monteggia has observed, "*If the obliteration of the artery is retarded, the forceps equally divides the artery by causing the death of the included portion. I also saw, in one case, the extremity of the instrument resting at the bottom of the wound on the subjacent femoral vein, rupture its anterior half also, although we were sure it had not been included by it.*" (*Instituz di Chir.* ed. 2. t. ii.) And, although Cumano, in a case of popliteal aneurism, obtained, on the fourth day, the closure of the femoral artery, by means of Assalini's forceps, he does not conceal that the cure of the wound was rather difficult; and, in comparing the ligature with the forceps, he adds his belief, that if an equal result is derived from both, the preference will be given to the ligature, unless the other instrument be brought to such perfection that the inconveniences will be removed from which he found it not exempt, though the operation succeeded. (*Annali di Méd. del Dottore Omodei,* Settembre, 1807, p. 309.; and *Scarpa, On Aneurism,* p. 45. ed. 2.) Some experiments were a few years ago instituted by Mr. Travers, in order to determine the merit of Assalini's forceps, compared with the ligature; and his conclusions from the facts elucidated in the investigation is, that the ligature is a more powerful means of effecting the obliteration of the tube of an artery. (See *Med. Chir. Trans.* vol. vi. p. 643. &c.)

The substance called silkworm gut, used by anglers, was proposed to the profession for securing arteries, in the year 1818. (See *Experiments in favour of a new Substance for tying Arteries, and for Suture, by Joseph M'Sweeny, M.D.* in the *Edinburgh Medical and Surgical Journal,* vol. xiv. p. 597.) It is described as round, smooth, amazingly strong, only as thick as horse-hair, thus adapted for cutting the internal coat of an artery; and it admits of being firmly knotted when moistened. In all the experiments where it was used, the wound healed kindly over it, and on killing the animal it was found unchanged. In the year 1826, Mr. Fielding drew the attention of surgeons to the subject of silkworm gut, not aware of Dr. M'Sweeny's experiments. This substance was employed for securing arteries, in various operations, with complete success; the wounds healed quickly over it. Mr. Fielding has the merit of having first used it successfully in operations on the *human body*. (See *Trans. of the Medico-Chirurgical Society of Edinburgh*, vol. ii. p. 340.)

A few years ago, Mr. Lawrence extended to operations for aneurism, the method of tying the artery with a small firm silk ligature, the whole of which is immediately afterwards cut off, with the exception of the noose and knot, and an endeavour then made to heal the wound by the first intention. In a case of popliteal aneurism, Mr. Carwardine, late of Thaxted, tied the femoral artery in this manner, and the wound united entirely by the first intention, not a particle of pus having been formed at any time; and the part continued perfectly sound at the distance of some months from the operation. On the 29th of March, 1817, I saw Mr. Lawrence try the practice in a similar case: with the exception of the integuments, the wound united by adhesion. However, it continued to discharge a small quantity of matter till the end of May, when the ligature came away, and it healed firmly. In an aneurism of the brachial artery, Mr. R. Watson of Stourport, Worcestershire, tied that vessel and cut off the ends of the ligature, as proposed by Mr. Lawrence. The operation was done on the 2d of March, and the wound was quite healed by the 10th of April. On the 3d of May, a small tubercle which had been felt under the skin in the centre of the cicatrix, appeared above the skin, and proved to be the knot of the ligature. There was no inflammation, nor discharge; but the ring of the ligature was firmly impacted in the centre of the cicatrix. In about a week from this time, the whole of it was expelled. In another case, where Mr. Hodgson tied the ulnar artery, and cut off the ends of the small ligature, the skin healed over the vessel, but a firm almost cartilaginous knot gradually formed, from the centre of which the bit of ligature was extracted five or six months afterwards by a small puncture. (For additional observations, see *Med. Chir. Trans.* vol. viii. p. 490. &c.).

Although Mr. Carwardine's case is a strong one in favour of this method, I apprehend that, on the whole, the cures on record thus effected cannot be said to have been completed sooner than others generally have been, in which one end of the small circular ligature was left for the removal of the noose. Thus, in two cases, where the practice was tried by Mr. Norman of Bath, the results were by no means encouraging. In one of these instances, a part of the wound appeared to have united by the first intention, but *matter afterwards formed, and it was a considerable time before the ulcer healed.* The ligature was never seen to come away; but from the circumstance of the suppuration, Mr. Norman apprehends that it must have been voided. In a second example, the attempt to procure a permanent adhesion of the parts over the ligature did not succeed; a *long and troublesome suppuration ensued*, and the wound was not healed till the latter end of April, though the operation was done on the 7th of March. (*Norman, in Med. Chir. Trans.* vol. x. p. 120, 121.) As catgut, however, was employed for the ligatures in these two operations, I do not know that it is fair to consider the method exactly like that recommended by Mr. Lawrence, who particularly directs very small ligatures of dentist's silk to be used. But, besides the different material employed, we are left uninformed of the thickness of the catgut; and, in this respect, also, there would probably be no greater similarity between the ligatures of these gentlemen, than there was in regard to the substances of which such ligatures were made. In favour of catgut as a ligature, when the ends of it are to be cut off, a case published by Sir Astley Cooper, deserves particular notice. The wound was found completely united on the fourth day after the operation, notwithstanding the patient was eighty years of age. The catgut, previously to its application, was softened in warm water. The recovery was complete; a fact, strongly proving the propriety of not rejecting an operation on account of age, if no other objection exists. (See *Surgical Essays*, parti p. 126.) Sir Astley afterwards renounced both the use of catgut ligatures, and the plan of cutting off both ends of each ligature. With respect also to silk ligatures, it seems that little abscesses and hard knots occur even after their use in this manner, and these inconveniences have deterred surgeons generally from adopting the innovation. M. Manec tried the plan with ligatures composed of various animal substances, silk, catgut, filaments of nerves, tendons, &c.; and the result was, that the wound was never healed by adhesion over the extraneous substance, without abscesses afterwards forming for its discharge. Dupuytren observed the same thing. Lisfranc was a witness of two cases, in which the ligature was not absorbed, and severe consequences ensued. (*De l'Oblitération des Artères*, p. 55.) Some American surgeons, and especially Drs. Physic and Levert tied the artery with lead, gold, silver, or platina wire, and then cut off the ends of such ligature. They were led to adopt this plan by the consideration of the little irritation sometimes resulting from the presence of a metallic substance in the textures of the body, as illustrated in gunshot wounds. In experiments on animals, the artery was obliterated by the metallic wire, the part of which, left in the wound, became inclosed in a kind of little cyst, where it remained without inconvenience. It does not appear that the practice was ever tried on the human subject. However, I join Lisfranc in the belief, that if it were tried, it would be found liable to the objections urged against silk and catgut ligatures used in this way. (*De l'Oblitération des Artéres*, p. 57.) Be it recollected, also, that a bullet, or other metallic body, only occasionally lies in parts without causing inconvenience: much more frequently it tends to make its way outward, and bring on suppuration and ulceration. I coincide, then, with M. Lisfranc, and the great body of English and French surgeons, that, as the plan of removing both ends of the ligature brings no advantage to counterbalance its inconveniences, it should be relinquished, and the preference given to the method of cutting off only one end, and leaving the other hanging out of the wound. (*Op.* cit. p. 58.)

In cases of aneurism, a single small ligature, composed of dentist's silk, common silk, thread, inkle or twine, is now usually preferred by the majority of surgeons in England; but, as the right qualities of ligatures are elsewhere considered (see HEMORRHAGE and LIGATURE), I need not here dwell upon the subject. It is not meant to assert, that the use of a single ligature is never followed by secondary hemorrhage; for this would be untrue. The accident, I believe, will sometimes happen after this or any other mode, under certain circumstances, and in unfavourable subjects. A fact of this kind we find recorded, which happened in the practice of a truly eminent and experienced surgeon (see *A. Burns, On diseases of the Heart*, p. 230.); but, it appears to me, that, *cæteris paribus*, a single small ligature, *applied with as little disturbance and detachment of the artery as possible*, will be more rarely followed by secondary hemorrhage, abscesses, sinuses, &c., than any other known method. Thus, in the several cases, reported by Mr. Norman, the single ligature was never followed by any of those inconveniences which, he justly thinks, will be rarer after this practice than any other, "if the artery be not removed from its situation, or more detached, than the ligature separates it." (See *Med. Chir. Trans.* vol. x. p. 123.)

I have already insisted on the importance of tying a sound portion of the artery. Even a dilatation of it, unattended with calcareous or atheromatous depositions, is unfavourable to the success of the ligature. M. Lisfranc, in one instance of carotid aneurism, had only room for a ligature on a dilated portion of the common carotid, between the aneurism and the sternum: in a few days the artery gave way below the ligature, which had not quitted its place. (See *Lisfranc, de l'Oblitération des Artères*, p. 65.)

Before entering into the consideration of particular aneurisms, I wish to mention a few other circumstances, worthy the attention of every practical surgeon. The first is, the partial entrance of blood into the aneurismal sac, after the artery has been tied at some distance from the tumour. This fact was first particularly pointed out, and its reasons explained by Sir E. Home, who published three examples of its occurrence. (See *Trans. for the Improvement of Med. and Chir. Knowledge* vol. i. p. 173. and vol. ii. p. 239.) But I believe that it had never been considered with due attention, until Mr. Hodgson made it one of the subjects of his reflections in his valuable treatise.

"When an artery is tied close to an aneurismal sac, the ingress of blood into the latter is in most instances prevented; the coagulum, which it contains, is absorbed, and the membranes of which the sac is composed, gradually contract, until its cavity is permanently obliterated. But, when the artery is tied at a distance from the disease, the ingress of blood into the latter is not altogether prevented; for, the anastomosing branches, which open into the trunk, below the seat of the ligature, convey a stream, which passes through the aneurism. The impulse of this current, however, is so trifling, that the enlargement of the sac not only ceases, but the deposition of coagulum in it increases, in consequence of the languid state of the circulation. The coagulum accumulates, until the cavity of the sac, and the mouth of the artery leading into it, are obliterated," &c. (See *Hodgson, On the Diseases of Arteries*, p. 266.)

This fact, which is of great importance, both in a practical and pathological point of view, is proved (says this gentleman), 1st, by the occasional recurrence of pulsation in the tumour after the operation; 2dly, by cases in which the cavity of the sac has been exposed, and hemorrhage has been the consequence; and, 3dly, by dissection, in which it has been found, that the cavity of the aneurism, as well as that of the artery, from which it originated, was pervious, from the part which was obliterated by the direct operation of the ligature. For a detail of the facts, relative to this interesting point, the reader is referred to Hodgson's valuable publication (p. 267. *et seq.*).

Some very uncommon instances are recorded, in which the return or continuance of pulsation in the tumour is said to have prevented the cure; the aneurismal sac having begun to enlarge again. The two cases of this kind, however, which happened in the practice of Pott and Guerin (*Trans. of a Soc. for the Impr. of Med. and Chir. Know.* vol. i. p. 172.; and *Journ. de la Soc. de Santé* No. 3. p. 197.), cannot be well depended upon, as it may be doubted whether the artery was really tied. Some better established facts, relating to this part of the subject, have been very recently published. One is a case by Dr. Monteath, jun. of Glasgow, which is very remarkable; as the disease, viz. a popliteal aneurism, recurred nine months after the femoral artery had been unequivocally tied in the upper third of the thigh. On the 27th of February, 1819, this gentleman performed the operation, using a single ligature; the pulsation of the tumour in the ham instantly ceased; and the wound healed by the first intention, except where the ligature was situated, which came away on the thirtieth day. By this time the tumour was diminished to one half of its original size, and, in two months more, only a hard knot was perceptible, in which no pulsation whatever could be felt. After the considerable lapse of time above specified, the patient informed Dr. Monteath, that the tumour had reappeared, being rather larger than a plum. The pulsation in it was distinct, though not so strong as in ordinary aneurism. As the size of the swelling, and strength of the pulsation, increased gradually, a compress and bandage were applied, without confinement; but, as this treatment was ineffectual, the patient was afterwards kept in bed, bled, and put on a spare diet. A thick compress was placed over the tumour, and the limb was firmly bandaged from the toes to the groin. A trial of this plan for three days not having produced any benefit, a tight torniquet was applied over the tumour; but the pain was such in half an hour, that the instrument was taken off, from which moment no pulsation was felt. Next day the tumour not only did not throb, but had a firm feel; and, the bandage being continued, the cure was gradually completed. Had the disease not yielded to these means, Dr. Monteath meant to have tied the inguinal or external iliac artery, with the view of cutting off the supply of blood to the sac, through the anastomosing branches. (*Scarpa, On Aneurism by Wishart*, p. 510—512. ed. 2.)

The following cases were mentioned by Sir Astley Cooper:—A man underwent the operation for aneurism; the femoral artery was tied; the pulsation ceased; and the patient in a little while was supposed to be cured of the aneurism, and discharged. Upon his return to labour, however, a swelling arose in the ham, without pulsation. The swelling subsided in consequence of rest; but afterwards, while the man was at work, the swelling returned with great pain. At length, as Sir Astley conceived that there was no prospect of the limb becoming useful again, it was amputated. Upon an examination of the parts, he found that the femoral artery, below the place of the ligature, had been conveying blood. It does now and then happen (says he), that a blood-vessel will arise from the artery close above the ligature, and pass into the artery immediately below it, by which means the circulation is produced. Sir Astley then referred to a specimen in the hospital museum, where this fact is illustrated in the brachial artery. (See *Lancet*, vol. i. p. 298.) Mr. Jeffreys had a gardener under his care in St. George's Hospital, who had been operated upon by Mr. Gunning for a popliteal aneurism four years previously, and which appeared to have been cured; but the tumour returned a few weeks before the patient's re-admission. The limb was amputated, but the result was fatal. In the *post mortem* examination, the femoral artery was found obliterated for the space of half an inch, at the part where the ligature had been applied four years previously; and immediately below the impervious part, two branches, equal to half the diameter of the femoral artery, were observed to enter the continuation of that trunk. It was inferred, that the circulation through the aneurism had never been wholly suspended, and that the disease was a reproduction of the original tumour. (See *Guthrie, On Dis. of the Arteries*, p. 157.)

The external iliac artery was taken up by Mr. Norman of Bath, for the cure of an inguinal aneurism; and when the collateral circulation was fully established a few days after the operation, the tumour was again supplied with blood in sufficient quantity to produce a distinct pulsation; "a fact (says Mr. Norman) of practical importance, as it shows, that though the ligature on the iliac artery stops the direct influx of blood into the tumour, and is the means by which the disease is cured, yet that there exists a necessity for employing strict rest, the antiphlogistic regimen, and, in some cases, the abstraction of blood, to assist nature in her operation of obliterating the aneurism." And, in another instance, after the same gentleman had tied the femoral artery for the cure of popliteal aneurism, the pulsation, though stopped for a time in the tumour, afterwards recurred in such a degree, that much doubt was entertained whether the disease would have been cured by the ligature on the femoral artery, had not continued and rather powerful pressure been adopted. (*Med. Chir. Trans.* vol. x. p. 99. 118, &c.) Mr. Briggs also had a case exemplifying the recurrence of a popliteal aneurism some time after an apparent cure by the operation, and the successful employment of pressure on the artery in bringing about a permanent stoppage of the renewed pulsation, and the removal of the tumour. (See *Guthrie, On Dis. of the Arteries*, p. 157.) Another instance of the good effect of this practice, I shall presently notice: it was in a case under Mr. Liston.

M. Roux, in a late work, has offered some criticisms on the English method of operating for aneurisms. It would hardly be fair play to endeavour to offer a serious refutation of them, because, when he wrote, it was his misfortune not to be duly informed of all the facts and experiments recorded in the inestimable treatise on hemorrhage by the late Dr. Jones. "Still less confident than we are (says M. Roux) in the treatment by compression and in the use of topical remedies for the cure of external aneurisms, the English surgeons have immediate recourse to the operation with the ligature. Hunter's method is that which they universally practise. They will not even allow, that there are any cases in which the operation by opening the sac should be preferred. And it is singular, the very same motive, which would incline us in some cases of aneurisms, properly so called, to adopt the operation of opening the sac, is alleged by the English surgeons as a circumstance in favour of the Hunterian method. Let us suppose an aneurism so formed that near the centre of the tumour, or rather near the opening, by which the artery communicates with the swelling, are situated the orifices of the collateral arteries, which would be useful for the re-establishment of the circulation. Here, it is clear that in practising the operation by the Hunterian method, that is to say, in tying the artery above the tumour, the last ramifications are not indeed sacrificed; but the orifices and first branches of these collateral arteries. Let there be, for example, at the upper part of the femoral artery an aneurism, which, though formed originally below the origin of the profunda, now extends above it. Here it is manifest that, in tying the femoral artery above the swelling, we should lose the important resource of the profunda for re-establishing the circulation in the lower part of the limb. The desire and hope of saving the profunda would, in such a case, make us adopt the operation of opening the sac, in preference to the Hunterian method; and Scarpa himself, so great an advocate for this last mode,— Scarpa, who seems only to have composed this work to cry up this method, makes an exception of the case, which I have just been supposing. The English surgeons, on the contrary, would urge the following objection to the operation by opening the sac in this and other analogous examples. They contend, that the ligatures would be applied too near to the origin of the collateral arteries, which are to receive the blood after the operation. They are prepossessed with the idea, that, when an arterial trunk is tied at a given point, the too great proximity of the principal collateral arteries disposes to subsequent hemorrhage," &c. (P. 256, 257.), a circumstance which M. Roux seems to doubt.

Now, before attempting to reply to these observations, we ought to know what exact distance Roux means, when he speaks of the profunda, or a large collateral artery, originating near the opening by which the aneurism communicates with the main artery. Here he is not at all precise; and were he to tie the femoral artery immediately below the point where the profunda arises, he would expose his patient to great danger of bleeding. I say this, well aware of the case which he has adduced to prove the contrary. In the example brought forward, he applied several ligatures (P. 260.), some of which were the *ligatures d'attente*, or loose ligatures left ready to be tightened in case of need. These were of course higher up than the ligature which was tightened. It is therefore impossible that this last could have been close to the origin of the profunda. There must have been room left for the application of the *ligatures d'attente;* and be it also recollected, that when this operation was done, the French still persisted in the use of large flat cords, and not small firm round ligatures, which are now found to be most advantageous. (See HEMORRHAGE.) In that article, it is explained that the nearness of a collateral vessel impedes the formation of the internal coagulum, which has a material share in the process by which the artery is closed.

With respect to the circumstance of hemorrhage being more likely to follow, when the ligature is placed close below, than at some distance from a great collateral artery, there cannot be a doubt of the fact. M. Roux, when in London, saw an occurrence of this kind himself, and has published it in his book. It was a case in which Sir Astley Cooper tied the external iliac artery; but the patient died of hemorrhage a fortnight afterwards, and, on opening the body, it was ascertained that the obturator artery, which usually arises either from the trunk of the internal iliac, or from the epigastric, proceeded from the external iliac, and arose immediately above the point to which the ligature was applied. (See *Parallèle de la Chir. Angloise avec la Chir. Françoise, &c.* p. 278, 279.)

From a preparation, spoken of by Mr. Travers, from others in different museums, especially in that of the London University, and from some experiments which were made, it would appear that the presence of a collateral branch hinders the formation of the internal coagulum, but will not always prevent the closure of the vessel by the adhesive inflammation. In the preparation referred to by Mr. Travers, a ligature was applied to the external iliac, between the epigastric and circumflex iliac arteries, "and having been in contact with the former at the angle which it makes at its origin from the iliac, ulceration had taken place, and the bleeding had proved fatal. *There was no coagulum formed in the iliac trunk,* though the operation had been performed several days, the circulation through the epigastric having continued. *But the lymph-plug at the seat of the ligature on the iliac artery was complete.*" (*Med. Chir. Trans.* vol. vi. p. 656.) Indeed, it must be admitted that the fluidity of the blood does not prevent the adhesive process, a fact which, as Mr. Travers observes, is also proved by the indirect obstruction of a vessel, by means of a temporary ligature, or compressor. When, therefore, the vicinity of a large branch to the ligature is spoken of as a circumstance conducive to secondary hemorrhage, I mean that it is so, inasmuch as the internal coagulum is useful in promoting the closure of the vessel, and its formation is prevented.

It was either Brasdor or Desault, who first conceived, that, when an aneurism was so situated, that a ligature could not be applied to the artery leading to the swelling, a cure might possibly arise from tying the vessel on that side of the tumour, which was most remote from the heart. Desault conjectured that, by this means, the circulation through the sac would be stopped, the blood in it would coagulate, that the circulation would go on by the collateral arteries, and that the tumour would be finally absorbed. Deschamps tied the femoral artery below an inguinal aneurism; but the progress of the disease, instead of being checked, seemed to be accelerated by the experiment. The operator was obliged, as a last resource, to open the tumour, and try to take up the vessel. In this attempt the patient lost a large quantity of blood, and died eight hours afterwards. (See *Œuvres Chir. de Desault par Bichat,* t. ii. p. 563.; and *Recueil Périodique de la Société de Médecine de Paris,* t. v. No. 17.)

The operation of tying the artery below the tumour was repeated by Sir A. Cooper, not for an aneurism of the femoral artery in the groin, but for an aneurism of the external iliac, where tying the artery above the swelling was impracticable. The femoral artery was therefore tied immediately below Poupart's ligament, between the origins of the epigastric and the profunda. The pulsations of the tumour continued; but the progress of the disease was checked. After a time, indeed, the swelling decreased, and this in so considerable a manner, that hopes began to be entertained that perhaps the external iliac artery might soon admit of being tied above the disease. The ligatures came away without any unfavourable occurrence; and when the wound was healed, the patient was sent into the country for the benefit of the change of air. Afterwards, however, the tumour gave way; an extravasation of blood took place in the cellular membrane of the pelvis, and the patient died. Sir A. Cooper had no opportunity of seeing the case; and as the body could not be opened, further particulars were not obtained.

I believe no additional trials of this practice were made in any part of the world, and that, in fact, the general feeling of the profession was decidedly against it, until my friend, Mr. Wardrop, directed his particular attention to the subject, and both by reasoning and facts exemplified, that Brasdor's method of operating ought to be adopted in certain aneurisms, the circumstances of which forbid the application of a ligature on the cardiac side of the tumour. Experience has amply proved what I have already repeatedly mentioned, that, after the Hunterian operation, some flow of blood frequently continues through the aneurismal sac, owing to the anastomoses; but that the impetus of the stream having been sufficiently reduced by the effect of the ligature, the curative process is not prevented from taking place. The pulsation, which is sometimes felt for the first few days, at length subsides, in consequence of the circulation being stopped by the increased quantity of coagula, and the tumour begins to diminish. It is from facts of this kind that Mr. Wardrop deduces what he calls "a new principle for operating in aneurisms, so situated as hitherto to have been considered beyond the reach of art, and to which the Hunterian principle of operating is totally inapplicable." (*On Aneurism,* p. 15. 8vo. Lond. 1828.) Mr. Wardrop observes, that the changes produced by Brasdor's method, both in the artery and the sac, are precisely those which Nature employs when she cures the disease by a spontaneous process. No sooner is the ligature applied on the distal side of the aneurismal tumour, than, as after the Hunterian plan, the anastomosing vessels dilate, and perform the function of the obliterated or obstructed trunk. The cases in which the operation has been done, prove also what would not have been expected, that the tumour, directly after the application of the ligature, diminishes, instead of undergoing enlargement. "If the circulation be turned into a new channel, and if that channel completely fulfil the purpose, the sac, with its contents, as well as the portion of artery extending between the aneurism and the ligature, and also the blood contained in it, will now be in a passive state; and though the blood will continue, for a certain time, to be influenced by the impulse of the circulation, carried on in that part of the vessel, which passes into the tumour, still its motion must become not only languid, but its current irregular, a state which, we know, admits of its speedy coagulation. Whenever the coagulation of the blood does take place, then the cure of the aneurism may be said to be accomplished; the sac will contract; the coagulum will be absorbed; some portions in contiguity with the sac will become organised, and consolidate; others, if the quantity be very large, will escape by a process of ulceration through the skin; and ultimately, a gradual coalescence of the tumour will thus take place." (*Wardrop*, p. 20.) In the summer of 1825, this gentleman first tried Brasdor's method. The case was a carotid aneurism, in a female seventy-five years of age. The disease was so close to the clavicle, that it was quite impracticable to tie the vessel on the cardiac side of the tumour. Immediately the artery was tied, the swelling underwent a diminution. On the fourth day, it had lessened by one third. Afterwards the throbbing continued strong for a few days, at the expiration of which it became obscure, and at the same time the tumour began to diminish again. Previously to the complete cure, ulceration occurred, and several large masses of coagulated blood were discharged, along with some healthy pus. Three years after the operation, the patient continued to enjoy good health.

December 10. 1826, Mr. Wardrop attempted a similar operation for the cure of a carotid aneurism in another woman, aged fifty-seven. Some reduction of the throbbing, and other relief, are stated to have ensued; but the patient died of a complication of complaints on the 23d of the following March, 1827. " Up to the day of her death, a tumour remained in her neck, of about the bulk of an almond, which pulsated strongly, felt very thin in its coats, and its contents could be readily squeezed out of it, but returned rapidly when the pressure was removed." (P. 33.) In the dissection it deserves notice, that *the carotid was found completely pervious*, and that *no cicatrix, nor other appearance, enabled Mr. Bennet to ascertain the precise point to which the ligature had been applied.* (P. 35.) These circumstances might raise a doubt about the artery having been tied at all; but, supposing the ligature to have been duly applied, they prove to my mind the failure of the operation, inasmuch as the tumour and carotid artery were probably in almost the same state as if nothing had been attempted. The blood passed freely through them, and was not compelled to circulate through new channels. Without wishing, however, to enter into the question whether the artery were tied or not, I shall dismiss this example with two plain inferences: first, that, if the artery were tied, the operation failed to bring about the desired obliteration of the vessel, and coagulation of the blood in the swelling; secondly, that if it were not tied, what was done is neither favourable, nor unfavourable, to the practice of which we are now considering the merits. A third example of the operation is reported in vol. xii. of the Lancet. The carotid was tied above the aneurism by Mr. Lambert, March 1st, 1827, in the presence of Mr. Wardrop, Mr. B. Cooper, and Mr. Calloway. On the third day, the tumour seemed much consolidated and reduced in size. On the tenth day, there was some bleeding from the wound; but it was suppressed by the application of a compress wet with cold water; and in a few days the swelling had entirely disappeared, and all that could be felt of it; on pressing the finger deeply down, was a small hard tumour, having a very faint undulatory thrill. Unfortunately, this patient, also a female, fell a victim to hemorrhage on the 1st of May, in consequence of ulceration extending from the cicatrix through the platisma myoides to the artery. Without detailing other appearances noticed in dissection, suffice it to mention, that " at the root of the right common carotid artery was a consolidated tumour, of a pyramidal shape. A probe could not be passed upwards from the arteria innominata, and water forcibly injected at this part would not pass, so completely and effectually closed was the lower part of the carotid artery. On making a longitudinal section of the tumour, we observed at its lower part a firm coagulum of blood, of about the size of a French olive. It accurately closed the opening at the base of the carotid, and it was this which afforded the resistance to the probe and injection of water passing upward from the arteria innominata. The coats of the artery surrounding the coagulum were thickened to about four times their natural size, and lined by a thin layer of fibrine. Above the coagulum, the coats of the artery were thickened to the extent of at least six times their natural size, and, in addition to a layer of fibrine closely adherent to the inner surface of the artery, and continuous with that surrounding the coagulum at the lower part of the tumour, there were three other layers of coagulated lymph. —At the upper part of the thickened portion of the artery, and just above the omo-hyoideus, where the ligature had been applied, was an ulcerated opening on the anterior aud tracheal surface of the carotid artery, a quarter of an inch in length, and rather less in breadth, covered by a coagulum of dark-coloured lymph, communicating with the opening in the integuments." This case, according to my judgment, must be received as another proof that Brasdor's method is capable of producing those changes in the tumour, artery, and circulation, which, if not succeeded by some accidental untoward occurrence, like the ulceration, leading in this case to fatal hemorrhage, may bring about the perfect cure of the disease.

If any doubt remained of this fact after the cases already cited, it would be dispelled by the results of some other trials of the practice, and more particularly by the history of the case of Mary Covis, aged 36, on whom Dr. Bush operated, under very trying and difficult circumstances, with complete success. (*Lancet*, vol. i. 1828.) The tumour extended from the clavicle, on the right side, upwards nearly to the os-hyoides, pressing the trachea towards the opposite side, and passing under the sterno-mastoid muscle, to nearly an inch beyond its outer border. For nine days previously to the operation, the patient had not been able to swallow any thing; her respiration was alarmingly obstructed, and her voice nearly lost. In the operation, the artery immediately above the aneurism was found dilated, not more than half an inch of its extremity being sound, and on this a single silk ligature was placed. As soon as the artery was tied, the tumour became softer and less prominent; and though she had not swallowed any thing for nine days, she took, before the wound was dressed, about ten ounces of wine and water. The operation was performed September 11th, 1827. April 19th, 1828, the woman was in perfect health. There was then scarcely a remnant of the tumour; the inordinate action of the heart had ceased; and respiration and deglutition were natural. The facts recorded seem to Mr. Wardrop to prove, that the future growth of an aneurismal tumour may be arrested, and the disease cured, by placing a ligature on the distal side of the sac, especially if no branch of the artery intervene between the sac and the ligature; for, if a considerable branch, and one that afterwards enlarged sufficiently, were to be in this situation, the operation would have little or no effect in producing any diminution of the impetus of the blood in the aneurism, from the cavity of which the blood would pass as freely into the enlarged branch, as it previously did along the trunk itself. Hence we see why Brasdor's operation will probably be attended with greater success on carotid than other aneurisms, the common carotid artery giving off in its course no branches which would interfere with the principles of the practice. Of five operations of this description, which had been performed on the carotid artery at the period when M. Lisfranc published on aneurism, three were completely successful; and of the other two, one performed by Mr. Wardrop in December 1826, and the other by Mr. Montgomery, at the Mauritius, in 1829, the particulars leave doubts whether in one instance, the carotid artery had been tied, and whether the case was a carotid aneurism; and whether, in the other, the disease had not been an aneurism of the arch of the aorta. (See *De l'Oblitération des Artères*, pp. 100. 150.; and *Dupuytren, Clin. Chir.* t. iv. p. 593.)

Mr. Wardrop himself regards Brasdor's operation as not merely applicable to examples, in which it is impracticable to place a ligature on the cardiac side of the sac, but as likely to merit the preference when the tumour is large, and likely to inflame after the circulation through the sac is interrupted. This inference he makes from the fact of the immediate diminution of the swelling, which has usually followed the application of the ligature on the distal side of the aneurism. He also deems it probable that, in this method, there is less risk of hemorrhage from the part of the vessel on which the ligature is applied, than in the Hunterian operation. On the principle that it is sufficient for the cure of an aneurism, that the impetus of the blood through it be diminished, as the deposit of lamellated coagula within the sac will then increase, Mr. Wardrop urges the propriety of extending Brasdor's method to aneurisms of the arteria innominata; but the very interesting and valuable cases which are adduced in confirmation of his views of these particular aneurisms, will be more conveniently noticed in the sequel, where reference also will be made to some instances in which Brasdor's operation was practised for the cure of inguinal and subclavian aneurisms. As an admirer of the improvement of surgery, I must not quit this part of the subject, without expressing the conviction that I entertain of the service which Mr. Wardrop has rendered the profession and the public by his able and enlightened view of a valuable operation, which, without his exertions and example, might long have remained quite neglected, or briefly mentioned in the history of surgery as a dangerous proceeding, unworthy of further trials.

That Brasdor's operation must sometimes fail, and particularly that it should have failed in the trials made of it by Deschamps, Sir A. Cooper, and Mr. Anthony White (see *Guthrie, On Dis. of Arteries*, p. 90.) is not surprising. All these cases were inguinal aneurisms; and, it does not follow because the method will answer in carotid aneurisms, that it will answer in aneurisms in every other situation. I should say, indeed, that unless it retard *in a certain degree*, the circulation through the sac, or bring on considerable and deep inflammation of the parts, it will never answer in any case; and how much the first of these occurrences must depend upon the existence, or not, of one or more branches between the sac and the ligature, is completely obvious. It is no trivial consideration in favour of this method, that it had the approbation of the celebrated Dupuytren, who observes, that it is the only resource when an aneurism, situated too near the centre of the circulation, continues to increase, notwithstanding debilitating treatment and cold applications. As for the operations performed by Deschamps and Sir Astley Cooper, he expresses his conviction that their failure was owing to the origin of some important branch between the ligature and the aneurismal sac. When, however, no branch, capable of maintaining the circulation in the sac, is situated between this and the ligature. Dupuytren joins Wardrop, and others, in representing the probabilities of a cure as very great. The result, he adds, may also be favourable, although a few small branches may originate near the aneurism, because the coagulum, which is formed in the sac and internal trunk, will be likely to extend into them. But, says he, the presence of considerable branches, such as are capable of impeding the blood in the tumour from assuming a solid consistence, must evidently render the operation useless. Nay, what is worse, it may accelerate the fatal progress of the disease; because, when the blood has only a narrow outlet on the distal side of the aneurism, nature will make a perpetual effort to enlarge it, and in this progress the sac will be more and more distended. (*Dupuytren, Clin. Chir.* t. iv. p. 592.) The example, in which this eminent surgeon tried this practice on the axillary artery, will be presently noticed. The fact of the general failure of Brasdor's operation when any considerable vessels arise from the sac, or artery, on the cardiac side of the ligature, and the greater success that has attended such operations when performed for carotid aneurism than any other form of this disease, seem to me to justify the view of the principles on which this operation sometimes brings about a cure, entertained by Hodgson, Wardrop, and Dupuytren. I make this remark, fully aware of the suggestion of Mr Guthrie, that the cure so far as it goes, is affected by inflammation of the artery and sac, and not by the mere coagulation of the blood in them. (See *Guthrie, On Dis. of the Arteries*, p. 179.) He also enters into an inquiry how far the communicating of inflammation to an aneurism so near the heart as an aneurism of the innominata or lower part of the carotid, is an advisable proceeding. He argues, that too much inflammation kills the patient, while too little is insufficient to effect a cure. In support of his reasoning, Mr. Guthrie takes a different view of Mr. Montgomery's case from what that gentleman himself does; and on the following grounds:—"An aneurismal sac, of the size described in the first part of the case, never could disappear in four months by any of the processes of nature, or after any operation performed for its cure, with which we are at present acquainted; more particularly as the remains of the artery and vein were discoverable, although obliterated, by which I understand them to have become impervious. *There never was then an aneurism of the carotid;* but the aneurism, which was found to exist between the origin of the left carotid and the innominata, had formerly extended up the neck, so as to resemble an aneurism of the carotid. The operation on the carotid gave rise to inflammation, which extended first to the arch of the aorta, and to the aneurismal sac, and afterwards along the aorta to the heart and pericardium, which, in the end, destroyed the patient." (See *Guthrie, On Dis. of Arteries,* p. 198.) Whatever may have really happened in this instance, it will not form an adequate ground for the rejection of Brasdor's operation in examples where the aneurism is truly one of the carotid, and a ligature cannot be applied below the tumour. Indeed, M. Lisfranc argues, that Mr. Guthrie's objection of the inflammation being likely to be propagated to the heart, has no weight at all; for, says he, "If this consequence is so greatly dreaded after the ligature is placed on the distal side of the sac, how much more so must it be, when Anel's method is pursued! Besides, is the fear of such inflammation, which is after all very uncertain, a sufficient reason for renouncing the only hope of saving the patient?" *Lisfranc, De l'Oblitération des Artères,* p. 97.)

The memorable instance, in which Sir A. Cooper tied the aorta, in a case of inguinal aneurism, extending very high up, and already burst, I shall notice under the head AORTA. There I shall also advert to my friend Mr. James's and Mr. Murray's repetitions of the same bold operation.

In this article I have not yet mentioned the proposal made by Dr. Jameson, of Baltimore, to substitute for the ligature a seton composed of thread, or of a piece of doe-skin. The carotid of a sheep was transfixed with a needle, armed with a slip of doe-skin of a conical shape, three lines broad at its greatest extremity. The two ends of it were cut off three lines from the vessel. There was no hemorrhage during the operation. The animal was killed on the 22d day; and the coats of the artery were found considerably thickened for an inch above and below the seton. On one side of the vessel, there was no trace of the wound; but, on the other, there was a slight depression, containing a yellowish substance, which proved to be a small particle of doe-skin. The parietes of the artery were in contact, and every where united, excepting a flattened aperture, capable of admitting a small probe. The same experiment was repeated on the carotids of dogs by Dr. Jameson, and also by M. Worms, at the Val de Grace, in Paris, with similar results. M. Amussat varied the process by puncturing the artery with a curved needle, armed with a common thread, which was conveyed up within the tube of the vessel about an inch, and then brought out through the side of the vessel, by means of the needle. Then the ligature was drawn further up, till its lower end was entirely within the artery. A knot was next made near the vessel, and the rest of the ligature cut off. In small arteries, a clot was produced round the thread, and the artery became obliterated. In vessels above a certain size, no clot was found.

With respect to setons, as substitutes for the ligature in the treatment of aneurism, I am of opinion that they promise no advantage whatsoever, and, as being less likely to produce the desired obliteration of the artery, should never be employed on the human subject. I entertain the same opinion of acupuncture, which has been tried by M. Velpeau, M. Amussat, and Mr. Benjamin Phillips, on the arteries of animals. In some of these experiments, one or more needles or pins were thrust through the arteries without any preliminary exposure of these vessels; while, in others, the arteries were first laid bare. The accounts given of these experiments prove, that the obliteration of the vessel by the plan is a matter of great uncertainty; and that in several instances, where the attempt was made to transfix the artery through the undivided coverings, either it was not hit at all, or only pierced very near one of its sides. (*Lisfranc, De l'Oblitération des Artères,* p. 77.; also *Mr. B. Phillips, On the Cure of Aneurismal Tumours without the Knife or Ligature.*) Besides, it is doubtful whether the arteries of the human body can be so easily rendered impervious, or the process of reparation be so favourably carried on in them, as in the arteries of animals. As Mr. Guthrie observes, it is probable that a simple puncture with a needle would sometimes heal; but he has seen two instances, "in which the femoral artery was wounded with a tenaculum, and ulceration followed by hemorrhage took place in both, requiring application of a ligature." (See *Guthrie, On Dis. of Arteries,* p. 212.)

I shall finish these general observations on the treatment of external aneurisms, or such as admit more particularly of surgical treatment, with observing, that, in England, surgeons now lose few patients either from gangrene of the limb or secondary hemorrhage; and this, notwithstanding they may sometimes prefer applying a ligature above the profunda to cutting open the aneurismal tumour. I firmly believe, that such matchless success is to be ascribed to the perfection in their mode of operating; the choice of a proper kind of ligature; the right plan of applying it; the rejection of the employment of several ligatures at a time; the great care taken to promote the healing of the wound as quickly as possible; the avoidance of all unnecessary and hurtful extraneous substances in the wound; and, above all, the relinquishment of the formidable proceeding of cutting open the tumour.

In the consideration of particular aneurisms, I shall begin with those which may be cured by a surgical operation; and here we shall be fully satisfied that "*l'art de guérir ne triomphe jamais plus heureusement que lorsq'il peut employer la médicine efficace, c'est à dire, les moyens chirurgicaux ou opératoires.*" (*Pelletan, Clinique Chir.* t. i. p. 110.)

Of the Popliteal Aneurism, and Operation for its Cure.

Notwithstanding the solitary example in which M. A. Severinus, early in the 17th century, tied the femoral artery near Poupart's ligament in a case of aneurism (*De Efficac. Méd.* lib. i. p. 2. c. 51.), the practice of tying arteries wounded either by accident or in the performance of surgical operations, and even the plan of tying the brachial artery for the cure of the aneurism at the bend of the arm, were known long before the operation for the relief of the popliteal aneurism was attempted. The considerable size of the femoral artery, its deep situation, the urgent symptoms of the disease, and ignorance of the resources of nature for transmitting blood into the limb after the ligature of the vessel, are the circumstances which appear to have deterred former surgeons from this operation.

Valsalva treated popliteal aneurisms on the debilitating method, and published one or two equivocal proofs of its success. In Pelletan's first memoir on aneurism, and in the 3d vol. of Sabatier's *Médecine Opératoire*, as I shall hereafter notice again, are two cases of axillary aneurisms, which were cured by Valsalva's treatment. But encouraging as such examples may be, experience is not yet sufficiently favourable to this practice to allow it to bear a comparison, in point of efficacy, with the surgical operation, or to justify the general rejection of this last more certain means of cure. As Pelletan admits, Valsalva's treatment is extremely severe; the event of it doubtful; and were the plan to fail, the patient might not be left in a condition to bear an operation, for the success of which it seems necessary that a certain strength of vascular action should exist, in order that the blood may be freely transmitted through such arterial branches as are to supply the places of the main trunk after it has been tied. The time, therefore, has not yet arrived when surgical operations for the relief of aneurisms can be relinquished. (*Clinque Chir.* t. i. p. 114.)

The cure of popliteal aneurisms by means of compression is occasionally effected; but it happens too seldom in these cases to claim a great deal of confidence, or to lessen in any material degree the utility and importance of operative surgery. Pelletan records the cure of one popliteal aneurism by compression and absolute repose, during eleven months (t. i. p. 115.); Boyer relates two instances (*Traité des Mal. Chir.* p. 204. t. ii.); one is mentioned by Richerand (*Dict. des Sciences Méd.* t. ii. p. 96.); the practice of Dubois is said to have furnished several examples of the same success (vol. cit. p. 97.); and a case, in which Dupuytren effected a cure by compressing the femoral artery by means of an instrument applied just above the place where the vessel perforates the tendon of the adductor magnus, is detailed by Breschet (*Fr. Transl. of Mr. Hodgson's Work*, t. i. p. 249., &c.). Dupuytren's tourniquet, improved by Colombat, was tried, however, by Professor Regnoli; and, although the greatest care was taken to tighten it only gradually, the part became so painful that, after two or three applications, the instrument was obliged to be discontinued. (See *Istoria e Riflessioni intorno un Aneurism a Popliteo, &c.* p. 7. 8vo. Pisa, 1833.)

The circumstances under which the employment of compression affords the best chance of success have been already mentioned, as well as the prudence of assisting this plan with perfect quietude, venesection, spare diet, and cold astringent applications, especially ice, which was first recommended by Donald Munro, and subsequently praised by Guerin.

Aneurisms in general, and, among them, the popliteal case, are all attended with some little chance of a spontaneous cure; yet this desirable event is too uncommon to be a judicious reason for postponing the operation, especially as it is the usual course of the disease to continue to increase; while, in the early stage, the cure may be more speedily accomplished. In fact, when the patient is not too much debilitated, the experience of modern operators leaves no ground for apprehending, that the anastomoses will not suffice for the due nourishment of the leg, and consequently proves, that waiting beyond a certain time for the enlargement of the collateral vessels to take place is altogether an unnecessary and a disadvantageous method. Popliteal aneurisms, as well as other external tumours of the same nature, stand some chance of a spontaneous cure, when any cause induces a general, violent, and deep inflammation all over the swelling; for, then the communication between the sac and the artery is likely to become closed with coagulating lymph, and the pulsation of the tumour to be suddenly and permanently stopped. If, in this state, the disease sloughs, and the patient's constitution holds out, the coagulated blood in the sac and the sloughs are gradually detached, leaving a deep ulcer, which ultimately heals. An example, in which a popliteal aneurism was cured by such a process, is related in the *Trans. for the Improvement of Med. and Chir. Knowledge*, vol. ii. p. 268.

In former times, when all hopes of curing a popliteal aneurism by Valsalva's method, by compression, or a natural process, were at an end, amputation of the limb was considered as the sole and necessary means of saving the patient's life. But, about fifty years ago, the confidence of surgeons in the sufficiency of the anastomosing vessels for the continuance of the circulation began to increase; and, in opposition to the tenets of J. L. Petit and Pott, experience soon proved, that, in general, not only might the patient's life be saved, but his limb also, and this, without any operation that could be compared with amputation, in regard to severity. On looking back to the history of amputation, we shall find that A. N. Guenault was one of the earliest writers who disapproved of amputation as not truly necessary in cases of popliteal aneurism.

It is alleged that Teislere, Molinelli, Guattani, Mazotti, and some other celebrated Italian surgeons, were the first who ventured to tie the popliteal artery for the cure of aneurism. The path, as Pelletan remarks, had been pointed out to them by Winslow and Haller, whose valuable descriptions and plates of the arterial anastomoses about the knee-joint showed by what means the lower part of the limb would be nourished, after a ligature had been placed on the principal arterial trunk. For almost thirty years, however, the practice of tying the popliteal artery was confined to the Italian surgeons. Pelletan believes that he was the first who attempted such an operation at Paris, nearly thirty years ago (alluding to about the year 1780, the *Clinique Chirurgicale* being dated 1810).

However, this operation of opening the tumour and tying the popliteal artery itself, was a severe and often a fatal proceeding, and does not admit of being compared with the Hunterian operation, in point either of simplicity, safety, or success, as I shall explain, after the detail of a few particulars relating to the popliteal aneurism.

On whatsoever side of the artery the tumour is produced, it can be plainly felt in the hollow between the hamstrings, and in general its nature is as easily ascertained by the pulsation in every part of it. In the early stage of spontaneous aneurism, the swelling is soft, not usually accompanied by pain, and capable of being lessened by pressure, and more particularly by compression of the artery above the tumour, whereby the flow of blood into it is stopped, or materially diminished. The pulsation then ceases, but is restored on the compression being removed; and with the return of the pulsation, and that of the swelling to its original size, a peculiar thrilling feel is experienced, arising from the passage of the blood into the aneurism again from the artery, and termed by the French *bruissement*, because attended with a confused, rattling sound. After the swelling has existed a little while, the *bruit de soufflet*, or bellows sound, is likewise more audible, especially when the stethoscope is employed. At length the tumour becomes firmer, and the blood cannot be entirely pressed out of it, because the interior of the sac is now more or less covered by solid lamellated blood. The patient, in order to avoid bearing much on the affected limb, limps in the early stage of the case; but, "as the aneurism increases, he does so from two causes—the pressure which takes place on the nerves passing to the toes, and which gives rise to pain, not in the part affected, but in that to which the terminations of the nerves are distributed; and, from the same cause, giving rise to contraction of the muscles, and rigidity of the tendons passing behind the joint, the leg is permanently bent; the toes and leg are extremely painful; and the foot and leg, incapable of bearing the weight of the body, become swelled and œdematous." (See *Guthrie on Dis. of the Arteries*, t. i. p. 109.) Sometimes, however, the patient, even in the spontaneous form of the disease, does complain of great pain in the ham, and of numbness in the leg and foot, instead of pain in those parts. (See *Case by Collis, in Dublin Journ. of Med. Science*, vol. v. p. 33.) The symptoms of a popliteal aneurism, as they present themselves, when the sac gives way under the integuments and fascia, or under the heads of the gastrocnemius, I need not repeat, as they have been noticed in the general observations on aneurism. The progress of a popliteal aneurism differs in different examples; being sometimes slow, in other instances rapid. Mr. Collis had a patient with an aneurism in each ham, and the disease continued almost stationary from 1818 to 1833, during all which time so little inconvenience was experienced by the patient, that he was able to discharge the fatiguing duties of an infantry soldier. See *Dublin Journ. of Med. Science*, vol. v. p. 32.) I had a patient with popliteal aneurism, who, in his business of an organ-builder, used to ascend ladders, and lead a very active life for a considerable length of time; indeed, until the sac gave way, and the disease changed into the diffused form. (See *Med. Chir. Trans.* vol. xvi.) Though the disease may not occur in the popliteal artery so often as in the aorta itself, it certainly is seen more frequently in the former vessel, than any other branch derived from the aorta. As Sir E. Home has observed, this circumstance has never been satisfactorily explained; and, what is rather curious, in many instances of this disease, the patients have been coachmen and postillions. Morgagni found aneurisms of the aorta most frequent in guides, post-boys, and other persons who sit almost continually on horseback; a fact, which he imputes to the concussion and agitation to which such persons are exposed. Some allusion to this subject has already been made in the foregoing pages. Whether an explanation of the frequency of popliteal aneurisms can be correctly referred to the force with which the blood must be impelled against the bend of the artery when the knee is in a state of flexion, seems questionable, though it is on a similar principle that the great frequency of aneurisms of the curvature of the aorta is attempted to be solved. (*Home, in Trans. for the Improvement of Med. and Chir. Knowledge*, vol. i. &c.; and *Monro, in Ed. Med. Essays*, vol. v.) Were this the only, or even the principal, cause, surely one would have reason to expect aneurisms to be at least as frequent in the axilla, and in the bend of the elbow, as in the ham.

The popliteal aneurism was once supposed to arise from a weakness in the coats of the artery, independently of disease. If this were true, we might reasonably conclude, that, except, at the dilated part, the vessel would be sound. Then the old practice of opening the sac, tying the artery above and below it, and leaving the bag to suppurate and heal up, would naturally present itself. As the arterial coats were found to be altered in structure higher up than the tumour and the artery immediately above the sac, seldom united when tied, but, when the ligature came away, the patient was destroyed by hemorrhage, Mr. Hunter concluded, that some disease affected the coats of the vessel, before the actual occurrence of aneurism. Dissatisfied with Haller's experiments on frogs, showing that weakness alone could give rise to aneurism, he tried what would happen in a quadruped, whose vessels were very similar in structure to the human. Having denuded above an inch of the carotid artery of a dog, and removed its external coat, he dissected off the other coats, layer after layer, till what remained was so thin, that the blood could be seen through it. In about three weeks the dog was killed, when the wound was found closed over the artery, which was neither increased, nor diminished in size.

It being conjectured that the prevention of aneurism, perhaps, arose from the parts being immediately laid down on the weakened portion of the artery, Sir E. Home stripped off the outer layers of the femoral artery of a dog, placed lint over the exposed part of the vessel to keep it from uniting to the sides of the wound, and, in six weeks killed the animal, and injected the artery, which was neither enlarged nor diminished, its coats having regained their natural thickness and appearance.

These experiments strengthened Mr. Hunter's belief, that aneurismal arteries are diseased; that the morbid affection frequently extends a good way from the sac along the vessel; and that the cause of failure, in the old operation, arose from tying a diseased artery, which was incapable of uniting before the ligature separated. These reflections led him to propose taking up the artery in the anterior part of the thigh, at some distance from the diseased portion, so as to diminish the risk of hemorrhage, and be enabled to get at the vessel again, in case it should bleed. The stream of blood into the sac being stopped, he concluded that the sac and its contents would be absorbed, and the tumour gradually disappear, so as to render any opening of it unnecessary.

The first operation of this kind, ever done, was performed on a coachman, by Mr. Hunter, in St. George's Hospital, December, 1785. An incision was made on the anterior and inner part of the thigh, rather below its middle, which wound was continued obliquely across the inner edge of the sartorius muscle, and made large, in order to facilitate the performance of whatever might be necessary. The fascia covering the artery was then laid bare, for about three inches, after which the vessel itself could be felt. A cut, about an inch long, was then made through the fascia, along the side of the artery, and the fascia dissected off. Thus the vessel was exposed. Having disengaged it from its connections by means of the knife and a thin spatula, Mr. Hunter put a double ligature under it with an eye-probe. The double ligature was then cut, so as to make two separate ones. The artery was now tied with both these ligatures, but *so slightly as only to compress the sides together.* Two additional ligatures were similarly applied a little lower, with a view of compressing some length of artery, so as to make amends for the want of tightness, as it was wished to avoid great pressure on any one part of the vessel. The ligatures were left hanging out of the wound, which was closed with sticking-plaster. On the second day the aneurism had lost one third of its size, and, on the fourth, the wound was every where healed, except where the ligatures were situated. On the ninth, there was a considerable discharge of blood from the apertures of the ligatures, but it ceased on applying a tourniquet, and did not recur. On the fifteenth day after the operation, some of the ligatures came away, followed by a small quantity of matter; and about the latter end of January, 1786, the man went out of the hospital, the tumour having become still less. In the course of the spring, abscesses in the vicinity of the cicatrix followed, and some pieces of ligature were occasionally discharged. In the beginning of July, a piece of ligature, about one inch long, came away, after which the swelling went off entirely, and the man left the hospital again on the 8th perfectly well, there being no appearance of swelling in the ham. This subject died of a fever in March, 1787, and, on dissection, the femoral artery was found impervious from the giving off of the arteria profunda down to the place of the ligature, and an ossification had taken place for an inch and a half along the course of this part of the vessel. Below this portion the vessel was pervious, till just before it came to the aneurismal sac, where it was again closed. What remained of the sac was somewhat larger than a hen's egg, and its communication with the popliteal artery was obliterated. The rest of the particulars of the dissection are very interesting. (See *Trans. for the Improvement of Med. and Chir. Knowledge*, vol. i. p. 153.)

This celebrated case completely established the important fact, that simply taking off the force of the circulation is sufficient to cure an aneurism, the tumour being afterwards diminished and removed by the action of the absorbent vessels. In order to confirm the same fact, Sir E. Home related a case of femoral aneurism, which got well without an operation, but, on a similar principle to what occurs when the artery is tied. A trial of pressure had been made without avail. The tumour became very large, and such inflammation took place in the sac and integuments, that mortification was impending; no pulsation could now be felt in the tumour, or the artery above it. The correct inference of Sir E. Home was, that a coagulum, which we know always occurs in an artery previously to mortification, seemingly to prevent bleeding, had formed in this instance, and, in conjunction with the effusion of coagulable lymph about the root of the aneurism, had kept the blood from entering the sac.

Mr. Hunter's second operation was on a trooper. Instead of using several ligatures, which were found hurtful, he tied the artery and vein with a single strong one; but, unluckily, the experiment was made of dressing the wound from the bottom, instead of attempting to unite it at once, and the result was, that the man died of hemorrhage.

After this case, Mr. Hunter's practice was to tie the artery alone with one strong ligature, and unite the wound as speedily as possible.

Having recorded Mr. Hunter's cases, which first established the present method of operating for the cure of popliteal aneurisms, I shall not repeat the strong reasons which exist against the employment of reserve-ligatures; metallic compressors; two ligatures, with the division of the vessel between them; the interposition of pieces of linen, wood, cork, agaric, &c. between the knot and the vessel; the use of large ligatures; and other contrivances, the merits, or rather demerits, of which have been already fully considered in the preceding section. My next duty is to explain the method of performing the Hunterian operation, as brought to its modern state of improvement, and adapted to the wise principles which first emanated from the valuable experiments and investigations of Dr. Jones. (See HEMORRHAGE.)

In the arrangement of the assistants, one of them should be so placed, that, if required, in consequence of any accidental wound of that vessel in the operation, he can compress the femoral artery as it passes over the brim of the pelvis; but, as Scarpa justly observes, no pressure of this kind is to be made, unless the accident referred to should happen, because the pulsations of the artery, inasmuch as they indicate the track of the vessel, must tend materially to facilitate the operation. The surgeon is to explore with his forefinger the course of the artery from the crural arch downwards; and when he comes to the place where the vibration of this vessel begins to be less distinctly felt, this *point is to be fixed upon for the lower end of the external incision.* This angle of the wound will fall nearly on the inner edge of the sartorius, just where this muscle crosses the track of the femoral artery, and at the very apex of the triangle formed by the convergence of the triceps and vastus internus. A little more than three inches above the place here fixed upon, the surgeon is to begin, with a convex-edged bistoury, the incision through the integuments and cellular substance, and carry the wound down the thigh, in a slightly oblique line, from without inwards, so as to make it follow the course of the artery, as far as the apex of the above-mentioned triangular space, or the point where the vessel passes under the inner edge of the sartorius muscle. In order to make this first external incision with correctness, I consider it a good rule always to take particular notice of the line described by the sartorius on the thigh, the inner margin of which muscle, at the place where it meets the artery, as we have seen, forms at once the lower boundary of the incision, and an important guide to the vessel itself. By observing the track of the sartorius attentively, we shall likewise avoid all chance of making the wound too low down, so as to have this muscle intervening between the incision and the artery; a greater source of embarrassment in the operation, and of troublesome consequences afterwards, than, perhaps, any other error; for when this has happened, and the surgeon has not room enough afforded by the higher part of the wound to get at the artery above the sartorius, he is compelled to dissect and raise up this muscle from its natural connections, ere he can plainly discover the vessel. This inconvenience made a deep impression on me in the first case, where I tied the femoral artery; for the intervention of the sartorius in a stout soldier, upon whom the operation was done, threw me into the dilemma of either dissecting at the outer edge of this muscle, and drawing it inwards, or of enlarging the wound upwards. The latter proceeding was that to which I gave the preference, because it seemed to me an excellent maxim in this operation, to avoid making any further detachment of parts from their natural connections than is absolutely necessary; and I knew, that when the wound was extended a little higher up, the artery would present itself more superficially, quite unconcealed by any muscle whatever. In fact, in the superior third of the thigh, the anterior surface of the artery is covered only by the common integuments, the superficial fascia, the inguinal glands, the fascia lata, a little cellular tissue, and the arterial sheath. But in the middle third of the limb the vessel is more deeply seated, as, in addition to the skin, superficial fascia, fascia lata, cellular tissue, and arterial sheath, it is covered by the sartorius muscle, beneath which is a fascia composed of oblique fibres, passing from the tendon of the adductor longus and magnus muscle to the vastus internus. (See *Dr. Quain's Elements*, p. 506. ed. 2.) This last fascia begins superiorly at the point where the sortorius first passes in front of the artery, and is here thin; but, about the middle of the thigh, it is very dense. It terminates at the upper part of the inferior third of the thigh, in a well-defined edge, beneath which passes the nervus saphænus major. If this fascia be divided the femoral artery and vein will be exposed. (See *Harrison's Surgical Anatomy of the Arteries*, vol. ii. p. 136. ed. 2.) Anatomy teaches us, then, that the femoral artery may be more readily taken up in the superior third of the thigh than in the middle. Strongly, therefore, as my principles lead me to condemn Scarpa's modification of the ligature, his use of from four to six threads, and his interposition of a roll of linen between the knot and the vessel, I feel pleasure in expressing my conviction of one excellence in his mode of operating; an improvement which is now obtaining, if it has not already obtained, the universal approbation of the surgical profession. This amendment consists in making the incision in the upper third of the thigh, or a little higher than the place where Mr. Hunter used to make the wound. Scarpa's reason for this practice is to avoid the necessity of removing the sartorius muscle too much from its position, or of turning it back, to bring the artery into view, so as to be tied. I have seen the best operators, even professors of anatomy, embarrassed, by having the sartorius muscle immediately in their way after the first incision; and as the vessel is more superficial a little higher up, not being covered there by the sartorius, or the dense fascia extended from the adductor muscle to the vastus internus lower down the thigh, while the place is further from the diseased part of the artery, and there is no hazard of the anastomoses failing to keep up the circulation, this part of Scarpa's practice is highly deserving of imitation.

"The part of the limb (observes Mr. Hodgson) in which the femoral artery can be tied with the greatest facility, is between four and five inches below Poupart's ligament. The profunda generally arises from the femoral artery an inch and a half, or an inch and three quarters, below Poupart's ligament: it very rarely arises so low as two inches. If, therefore, the ligature be applied to the femoral artery at the distance of four or five inches below Poupart's ligament, the surgeon will not be embarrassed by meeting with the profunda during the operation, and the chance of causing secondary hemorrhage, by tying the artery close to the origin of this vessel, will be obviated." (*On the Dis. of Arteries, &c.* p. 434.)

The trouble, arising from cutting too low down, so as to have the sartorius between the outer wound and the artery, may be more accurately estimated, when it is known that Desault, for the removal of this inconvenience, considered it right to make a complete transverse division of that muscle, a thing which, it is said, may be done without ill consequences. (*Boyer, Traité des Mal. Chir.* t. ii. p. 145.) I shall not presume, however, to second this last piece of advice, because the artery can always be taken up very well, without such a proceeding.

A few years ago, Mr. A. C. Hutchison published a tract, in which he is an advocate for the practice of making the incision at the outer edge of the sartorius, and then raising that muscle, and drawing it inwards, in order to arrive at the artery. This advice proceeded from the apprehension, that the plan of taking up the femoral artery at the inner edge of the sartorius was attended with risk of injuring the saphenal vein, and large lymphatics. (*Letter on the Operation for Popliteal Aneurism*, 1811.) When the operation is done low down the thigh, the same method is commended by Boyer and Roux. (*Nouveaux Elémens de Méd. Opératoire*, t. i. p. 729.) But, as operating in this situation is liable to the several objections of approaching too near the disease, of aiming at taking up the artery where it lies more deeply than it does higher up, and, of every inconvenience which may arise from the interposition, dissection, and reflexion of the sartorius muscle, the method ought to be rejected, unless it can be proved that so many disadvantages are fully counterbalanced by other considerations. If the plan which I shall presently recommend be adopted, there will never be the slightest risk of wounding the saphena vein: and, therefore, I do not consider it advisable or necessary, for the avoidance of this accident, to make the wound *precisely upon the sartorius*, as my intelligent friend Mr. Hodgson suggests; a method attended with the inconvenience of having the fibres of that muscle between the external wound and the artery, and perhaps inconsistent with the excellent directions which he afterwards delivers, concerning the right mode of performing the external incision, when he says, with Scarpa, that this cut should be "continued down to the fibres, which form the inner margin of the sartorius." (*On Diseases of Arteries, &c.* p. 436.) Indeed, the sartorius crosses over the artery so obliquely, that while it is quite external to this vessel above, it covers it in the middle third of the thigh, and lies internally to it below.

Now, if the point where the inner margin of the sartorius first lies over the artery be the proper place for the lower termination of the external incision, we shall clearly be deviating from the precise course of the vessel by letting the higher portion of the wound be over the fibres of that muscle. And, when it is further reflected, that the serious evils of wounding the trunks of the lymphatics in this operation are not demonstrated in modern practice, while the saphena vein may always be avoided with certainty and facility, I cannot admit that there is any solid reason for letting the situation and direction of the external wound be determined by such apprehensions. At all events, for the motives above explained, it should be a fixed maxim in the operation, in the upper third of the thigh, never to extend the wound lower than the point where the inner margin of the sartorius crosses the artery; and then all detachment and displacement of this muscle will be unnecessary, and every embarrassment, which might proceed from its interposition between the outer wound and the artery, will be completely avoided. The first incision should be made in the direction of the artery, that, is along part of a line extending from the middle of Poupart's ligament to the point where the inner margin of the sartorius and the artery meet; or, as I should say, in a direction inclined a little more out, in order to avoid the risk of cutting the great saphænal vein where it is passing through the fascia lata to discharge its blood into the femoral vein. In the living subject, the course of the great saphænal vein is often rendered very conspicuous when distended with blood, and its exact situation should be attended to by every operator.

With the view of preventing injury of the femoral vein, Mr. Carmichael recommended a plan, which is now always followed, namely that of introducing the needle on the pubic side of the artery, where the vein presents itself to view, and can be most easily avoided. He remarks, that the only part of the thigh, from Poupart's ligament to the tendon of the adductor magnus, in which the femoral vein is not completely covered by the artery, lies within the space which extends from Poupart's ligament to the point where the artery meets the sartorius muscle. At the part of this space, most distant from Poupart's ligament, the vein begins to disclose itself at the pubic side of the artery, from beneath which it emerges more and more as it ascends. (See *Trans. &c. of the Fellows, &c. of the King's and Queen's College of Physicians, Ireland*, vol. ii. p. 357.)

The femoral vein, in a few rare instances, has been found double. Thus, in the case recorded by Mr. Macready, the popliteal vein, in the lower part of the popliteal space, "consisted of but one trunk, as usual, and held its natural situation, with respect to the surrounding parts; but in the upper third of the popliteal space, it divided into two branches, which passed off at an acute angle, having one of the muscular branches supplied by the popliteal artery in the apex of the angle. The veins then ascended; one, the internal and posterior, holding its usual position, with respect to the artery, namely, posterior to it at first, but getting internal as it ascended; the other branch crossed the artery, and ascended anteriorly, and a little externally to it, which relation it held until it arrived at the upper third of Scarpa's space, where it crossed the artery again, and then, uniting with the internal, formed the femoral, which appeared dilated into a sinus. The vein then had the usual relation to the artery, but was somewhat larger." (*Macready, in Dublin Journ. of Med. Science*, vol. ix. p. 318.) In the same volume, p. 325., Mr. Goodall has recorded another example of double femoral vein. In the latter, the external branch crossed the artery twice. This occasional variety in the femoral vein is important, in relation to the operation for popliteal aneurism.

The skin and superficial fascia are to be divided, in the situation and to the extent above specified, down to the femoral fascia, under which the artery lies, and may be felt beating. The next object, therefore, is to divide the fascia, which is here much thinner than at the outer side of the limb, and may be cut with another stroke of the bistoury; or, (what is safer, with the view of abstaining from all chance of wounding the artery,) a slight cut may first be made in the fascia, the division of which may then be made to the requisite extent by introducing under it a grooved director, on which the further incision may be made with perfect security. The fascia is to be divided in the direction of the external wound, but, to what extent, is a point on which surgical writers differ, and, indeed, they must here differ, so long as they are not unanimous about the method of applying the ligature round the artery; because, if it be intended to use a broad ligature, with a cylindrical piece of linen interposed between it and the artery, or especially if it be designed to apply two ligatures and divide the vessel in the interspace, more of the artery must be exposed, and of course more of the fascia must be cut, than when it is simply meant to surround the vessel with a single small ligature. Such operators also as have contracted the pernicious habit of insulating the artery all round sufficiently far to let them thrust their fingers under it, will likewise require an extensive opening in the fascia. This detachment of the vessel for an inch or more, for the purpose of placing the finger under it, is a measure which deserves to be condemned in the strongest terms, as it is the very thing which produces some risk of injuring the saphena vein, and has a tendency to bring on secondary hemorrhage, inasmuch as it occasions unnecessary handling, stretching, and disturbance of the artery and surrounding parts, and an inevitable division of the vessels, by which the arterial coats are supplied with blood.

According to Mr. Hodgson, who wisely avoids all unnecessary separation of the artery from the surrounding textures, the extent of the cut in the fascia should be about an inch. On the contrary, Scarpa, who insulates and raises the vessel, previously to tying it, insists upon the prudence of cutting the fascia the whole length of the external wound; for, says he, if this practice be neglected, it most frequently happens, that, in the succeeding inflammatory stage, the bottom of the wound swells and becomes very tense, and the matter, which is formed under the fascia, not finding a ready exit, occasions abscesses which seriously retard the cure. But Scarpa, instead of planning a method of relieving the consequences, might have employed himself more to the purpose in considering how they were to be prevented, and why in his method they most frequently happened. Now, without laying any stress upon two wax ligatures, each composed of six threads, with an additional extraneous substance, viz. a roll of linen in the noose, we should be more surprised to hear, that the wound after his method did not become affected with swelling, tension, and suppuration, than that these were the usual effects. After describing the division of the fascia, he observes: "*With the point of the forefinger of the left hand, already touching the femoral artery, the surgeon will separate it from the cellular substance, which ties it laterally and posteriorly to the contiguous muscles; and making the point of the same finger pass gradually under and behind the femoral artery (supposing the surgeon has not enormously large fingers), he will raise it alone from the bottom of the wound, or (when it cannot be avoided) along with the femoral vein. If it is along with the femoral vein, the surgeon, holding the artery and vein thus raised, and almost out of the wound, will cautiously separate the vein from the artery with a bistoury, or spatula, or simply with his fingers,*" *&c.* (See *Scarpa on Aneurism*, p. 280. ed. 2.)

When we combine the irritation and mischief of all this work with the ill effects of filling the bottom of the wound with soft lint, I would ask what more certain plan could Scarpa or any other person have suggested for bringing on the unpleasant state of the wound, which he describes as most frequently taking place?

According to my views, Scarpa is right, however, in recommending a free division of the fascia, not only for the reasons stated by him for this practice, but because such division may be made without disturbing the artery, or detaching it from its natural connections, and particularly because, unless a free cut be made through the fascia, as well as the integuments, the finding of the artery, and the placing of a ligature under it, cannot be so promptly accomplished. Dupuytren even recommends dividing the fascia more extensively than the skin, which seems to me to be a step too far. (*Clin. Chir.* t. iv. p. 517.)

I shall suppose the fascia has now been divided, under which the surgeon distinctly feels the pulsations of the femoral artery, which is still invested by the cellular sheath. The femoral vein lies directly under this vessel, while the branches of the anterior crural nerve, separated from it by dense cellular substance, are more externally, yet somewhat more deeply, situated. The two long descending branches incline inwards as they descend, and come in contact with the sheath of the femoral vessels, where these are crossed by the sartorius: consequently, if the ligature be applied above the inner edge of the sartorius, they require no attention; but, if the artery be tied lower down, the larger of them, the nervus saphænus major, which runs for some way upon the sheath of the vessels, and then penetrates it so as to get into contact with the anterior and external side of the vessel in the middle third of the thigh, care should be taken not to include it in the ligature. The next object, therefore, is to pass a single ligature round the artery, without including, or in any manner meddling with, the subjacent femoral vein, or detaching and disturbing the artery. For this purpose, the best direction is that given by my friend Mr. Lawrence, especially when combined with Mr. Carmichael's plan of letting the needle be introduced on the pubic side of the artery. "After dissecting down to the artery, a slight scratch or incision may be made through the sheath close to the side of the vessel. Then, with a narrow aneurism needle, nearly pointed at the end, and made as thin at its edge as it can be without cutting, a single silk ligature is to be conveyed round it, the point of the needle being kept in contact with the artery. A needle of this form makes its way easily through the cellular substance, and the vessel is detached only in the track of the instrument." (See *Med. Chir. Trans.* vol. vi.)

Dupuytren, and several other eminent French surgeons, first pass a bent director under the artery, and then, by means of an eye-probe, which is pushed along the groove, convey the ligature under the vessel. This is an eligible method, when it is particularly desirable to see, before the ligature is passed, that nothing is raised but the artery itself.

Of the kind of ligature to be employed, I need only say here, that it should be a single one, composed of firm materials, in order to avoid the necessity for increasing its diameter more than would be desirable for reasons elsewhere considered. (See HEMORRHAGE and LIGATURE.) The ligature having been put under the artery, one end of it is to be drawn completely through the track made for it by the needle, which instrument is then to be taken away, leaving the ligature under the vessel. The ligature is now to be tied in a steady firm manner, but without any immoderate force, which can never be necessary even for the division of the inner coats of the vessel. In this part of the operation, a few practitioners give the preference to what is termed the *surgeon's knot*, and commend this plan of fastening the ligature; a plan, which consists in putting the end of the cord twice through the noose, before the constriction is made. The only good of the surgeon's knot is, that it does not so readily slip and loosen as a common one; but Scarpa thinks a simple knot best, as it does not, like the other, prevent the surgeon from calculating the force with which the artery is constricted. (*On Aneurism*, p. 281. ed. 2.) A better reason against the surgeon's knot, is the irregularity with which a ligature in this form will lie round the vessel. A simple noose should therefore be first made and tightened, and then a second one, so as to form a common knot; and now, as a matter of precaution against the possibility of the ligature slipping and becoming loose, the surgeon, if he pleases, can tie the knot once again. One end of the ligature is next to be cut off near the knot; and the sides of the wound are to be brought together with strips of adhesive plaster, the irritation of sutures being carefully avoided. The remaining end of the ligature should always be brought out at the nearest point of the external wound to the knot on the artery.

If by any accident the arteries were pricked in the operation, a double ligature should be passed under the vessel, and one part of it tied above, the other below the puncture. Thus, Mr. Collis, in endeavouring to separate the artery from the vein, "made a small opening, about the size of a pin's point, into the artery, from which a rapid jet of blood took place. The artery was immediately compressed against the os pubis, and a double ligature applied, one part of which was tied upon the highest exposed portion of the vessel, and the other upon the lowest, leaving between both about a quarter of an inch of the artery. (See *Dublin Journ. of Med. Science*, vol. v. p. 31.) The case ended favourably, and illustrates what should be done under similar circumstances in other operations for aneurisms. The manner of taking up the femoral artery in the middle third of the thigh, and in the groin, will be described under the head of ARTERIES.

The effects, which in general immediately follow the operation, are a total cessation of the pulsation of the aneurismal tumour; a manifest sinking and flaccidity of the swelling; a diminution of pain in the seat of the disease; and a strong vibration of the articular arteries round the knee. As Mr. Hodgson has remarked, the unusual influx of blood into the minute ramifications, when a main artery is suddenly rendered impervious, is generally attended with a remarkable increase in the temperature of the limb. After tying the femoral artery for the cure of popliteal aneurism, the same phenomenon occurs, at least after a short time, during which the temperature of the leg and foot frequently continues lower than that of the sound limb. But, in a few hours, it generally rises, and is sometimes several degrees higher than that of the opposite member. This state lasts several days, at the end of which time, the heat of the limb which had been operated upon will be found to be about the same as that of other parts of the body. (*Hodgson on Diseases of Arteries, &c.* p. 356.) It is only while the limb is colder than natural, that it ought ever to be fomented, or covered with flannel. In particular examples, there is no increase of temperature in the limb at any period after the operation; a fact, which Mr. Hodgson refers to the probability of a collateral circulation having already been established, in consequence of the obstruction to the passage of the blood through the main artery by the accumulation of the coagulum in the aneurismal sac. Of course, unless a collateral circulation be established, the operation cannot succeed, as the limb will mortify: it behoves us, therefore, to be aware of the circumstances which may prevent the due transmission of the blood to the inferior part of the limb. These are ably explained and commented upon in Mr. Hodgson's work: 1st, An extensive transverse wound, by which the principal anastomosing branches are divided. 2dly, Tight bandages and pressure operating so as to obstruct the same vessels. 3dly, The immense bulk of the tumour, and the pressure upon the principal collateral arteries. 4thly, Calculous depositions in the coats of the arteries of the limb. 5thly, Advanced age. 6thly, A languid state of the circulation; a fact, indicating the wrongness of venesection, as a general practice after the operation, though it may yet be right to adopt this treatment, where the pulsations return in the tumour with unusual strength, and appear to stop the diminution of the swelling. 7thly, The abstraction of heat from the limb by cold evaporating lotions; a plan, which can only be right, when there is a great increase of heat in the limb, a tendency to inflammation, or a return of strong pulsations in the tumour.

Sir Astley Cooper saw a case, in which the application of white-wash occasioned mortification, and the patient's death. In cold weather, he always covers the limb with flannel, or a stocking, and sometimes puts jars filled with hot water to the feet. (See *Lancet*, vol. ii. p. 42.)

If secondary hemorrhage were to occur, ought we to take up the artery higher up, or have recourse to direct pressure on the bleeding point? In one case under Mr. Collis, he applied a compress, pressed down with a screw affixed to an iron hoop about half an inch in breadth, and sufficiently long to encompass the thigh. With this instrument, any degree of pressure could be made on the artery, whilst little or none was made on other parts, and the collateral circulation remained free. The bleeding returned once, but was at length permanently stopped. "My chief object (says Mr. Collis) in recording this case, is to show the advantage to be derived from pressure properly made, in arresting secondary hemorrhage from such a vessel as the femoral artery, and the greater benefit likely to arise from such a mode of proceeding than from tying the artery higher up, which, in the majority of cases in which it has been tried, has failed of saving the life of the patient. (See *Dublin Journ. of Med. Science*, vol. v. p. 36.) Sometimes pressure will answer, and then the ligature of the artery higher up becomes unnecessary; but pressure may not succeed. In an interesting case under Professor Regnoli, the femoral artery was tied in the upper third of the thigh, and secondary hemorrhage took place about a week after the operation. The bleeding was suppressed for a time by pressure on the bleeding point, and the application of a bladder filled with ice to the wound. The hemorrhage returned, however, and Regnoli decided to take up the external iliac artery. This measure permanently stopped the bleeding; and, *though the artery was so completely ossified*, where it was tied, *that, on tightening the ligature, a remarkable crepitation was distinctly heard, and it was even apprehended that the ligature had broken the vessel completely through*, the ligature came away on the eighteenth day, without any bleeding. The artery, in fact, had become obliterated. In the end, however, the patient died of gangrene in the leg. (*Istoria, &c. intorno un Aneurisma Popliteo*, Pisa, 1833, p. 26, &c.)

When the operation is done according to the principles laid down in this article, the patient is not too old nor enfeebled, and the after-treatment is properly conducted, mortification cannot be said to be a frequent event. In one case, operated upon by Sir Astley Cooper in 1823, the whole of the foot and part of the leg mortified; but it should be noticed, that, in this instance, the whole limb was extremely swollen previously to the artery being taken up. (See *Lancet*, vol. i. p. 436.) In all his extensive practice, he has seen but three or four instances of a failure of the operation from gangrene. (*Lectures, &c.*, vol. ii. p. 60.) Mr. Liston has related one example, which he ascribed to the improper use of fomentations with hot salt water. (See *Edinb. Med. Journ.* No. 90. p. 3.) As, however, the patient seems to have been of a very phlogistic diathesis, and to have been attacked with inflammation of other parts, the reality of the alleged cause appears questionable. I have seen but one example of gangrene, and in that only one toe, and a portion of the skin of the instep, sloughed in a very debilitated subject. This partial gangrene of the foot was particularly noticed by Deschamps and Scarpa, the latter of whom regards it as an unusual thing, only likely to happen in old, weak, or unhealthy subjects; and "at any rate (says he), if this should happen in any of these enervated individuals, the patients may console themselves for the loss of one or two of their toes, with the cure of a popliteal aneurism, and the avoidance of a painful and dangerous incision in the ham, and of the tedious suppuration which would have followed it."

Sir Astley Cooper has known retention of urine brought on by the operation in one or two examples, and the use of the catheter indispensable. (*Lectures, &c.*, vol. ii. p. 58.) Sir Charles Bell met with a case, in which the femoral artery divided below the profunda into two equal branches, the most superficial of which was alone noticed and tied in the operation. The patient died of constitutional disturbance, arising from inflammation in the whole course of the sartorius. After two or three days, the pulsation of the tumour, which had been very strong, ceased in consequence of the coagulation of the blood within the sac; another fact, exemplifying that this desirable change will not be prevented by a current of blood being still propelled through the aneurismal cavity. (See *Quarterly Journ.* vol. iii. p. 607.)

Mr. Liston has recorded a case, in which the pulsation and tumour returned several months after the operation. "On consulting with Dr. Thomson, it was agreed to try the effect of methodical bandaging, from the points of the toes upwards, and a compress over the tumour, with rest, cold applications, and moderate diet." These means had the desired effect; and the patient did not complain much of those pains which so frequently remain after the operation for aneurism.

According to Mr. Liston, these pains are in general distinctly referrible to the sachro-ischiatic nerve and its branches, and are explained by the state of the vessels in the substance of the nerve. In the natural state, the neurilemal vessels, when injected, are not larger than sewing threads; but, when the enlargement of the collateral branches is requisite, owing to the obstruction of the trunk, they also are called on to contribute their share in the new circulation; and they become enormously distended. In one remarkable specimen, in which the limb was injected and examined fifteen years after the superficial femoral artery had been secured for aneurism in the ham, the vessels in the sacro-ischiatic nerve had attained the size of crow-quills, and were convoluted in an extraordinary manner. The pains in the limb, noticed by Mr. Liston as occurring after the operation, he acknowledges, however, are by no means so severe as those experienced previously, and which are produced by the compression and stretching of the nerves by the sac. (*Edinb. Med. Journ.* No. 90. p. 2.)

When the operation succeeds, a considerable portion of the artery above the aneurismal tumour is rendered impervious, the vessel indeed being sometimes converted into a solid cord from the origin of the profunda to that of the tibial arteries. (*A. Cooper, Med. Chir. Trans.* vol. ii. p. 254.) In general, however, the obliteration of the artery is less extensive; a fact, particularly noticed in one of Mr. Hunter's cases (*Trans. of a Soc. for the Improvement of Med. and Chir. Knowledge*, vol. i. p. 153.), and vainly urged by Deschamps, as a proof of the insufficiency of the new method. (See *Obs. et Réflexions sur la Ligature desp rincipales Artères blessés, et particulièrement sur l'Aneurisme de l'Artère poplitée*, p. 76. Paris, 1797.) It appears from the observations of Mr. Hodgson, that the artery generally becomes impervious, for the space of three or four fingers' breadth, at the place where the ligature is applied; below which part its tube is free, and continues so for some distance, when the obliteration again commences, and descends along a considerable extent of the popliteal artery to the origin of the inferior articular or tibial arteries. Thus, says this author, an insulated portion of the femoral artery preserves its cavity, from each extremity of which considerable anastomosing branches arise; the upper branches convey blood into the vessel, and the lower transmit it into anastomosing channels, that originate below the knee. (*On Diseases of Arteries, &c.*, p. 278.) Now, as Mr. Hodgson is unacquainted with any case, except that recorded by Sir Astley Cooper, where, after the modern operation, the artery was obliterated from the seat of disease in the ham to the part at which the ligature was applied, he thinks it probable that, in most instances, a double collateral circulation exists in the limb, after this method of cure.

In consequence of the motion of the blood being more or less impeded in the aneurismal sac by the application of the ligature to the femoral artery, the aneurismal cavity soon becomes completely filled with coagula, which even block up the adjoining portion of the arterial tube. The coagulated blood in the sac is afterwards absorbed; and a gradual diminution, and final disappearance of the aneurism in the ham ensue; with the exception of a slight induration, which sometimes remains, composed of a remnant of the sac itself, or of the fibrous parts of the blood. This slight hardness in the cavity of the ham occasions no inconvenience, and does not hinder the patient from performing the motions of the knee and leg with quickness and safety. (*Scarpa*, p. 257. edit. 2.)

After the operation, the circulation is carried on principally by the arteria profunda, whose branches communicate with the articular arteries of the popliteal, and with arteries sent to the knee by the anterior and posterior tibial. Large branches in the sciatic nerve, sent off by the arteria profunda, communicate very freely with the popliteal artery, the articular, and branches of the posterior tibial. As Sir Astley Cooper has further explained, the freedom of anastomosis sometimes leads to a reproduction of an aneurism. The femoral artery was tied by Mr. Key, and the patient, after being discharged cured, returned with a painful tumour in the ham, attended with an obscure pulsation. The limb was amputated, and a large artery, passing to the tumour, and situated nearly in the usual place of the femoral, required a ligature. (*Lectures, &c.* vol. ii. p. 60.)

When the advantages of the foregoing method of operating are contrasted with the dangers and severity of the practice of laying open the aneurismal tumour, and applying ligatures round the diseased part of the vessel, it is surprising to find any modern surgeons still expressing a preference to the latter mode of treatment under any circumstances whatsoever. Yet Boyer, Roux, and a few French surgeons, are in this way of thinking, which reminds me of their slowness to adopt, at every opportunity, union by the first intention, one of the greatest and most decided advances to perfection ever made in the practice of surgery. The severity and difficulties of the old method of operating, in cases of popliteal aneurism, are most faithfully depicted by Scarpa. In the ham, says he, the artery lies very deep. The space is limited and narrow, within which it can be brought into view and tied, without risk of tying along with it, or of destroying, some of the principal anastomoses formed by the articular arteries of the knee. On account of the depth of the artery, it is difficult to pass any instrument round it, without including other parts; and it is no less difficult to draw the ligature on the vessel with a proper degree of tightness. Scarpa then comments on the disadvantages of tying the lacerated, diseased part of the vessel, which is sometimes so high up, that, in order to apply the ligature above it, it is necessary to cut through the long head of the triceps, and make a passage through into the thigh. Or, the diseased or lacerated part of the artery is situated so low down in the calf of the leg, that it is impossible to avoid including, either in the incision, or the ligature, the lower anastomosing articular arteries, on the preservation of which the circulation and life of the subjacent part of the limb in a great measure depend. We must add to all this the violence unavoidably done to the great sciatic nerve, which an assistant must hold drawn to one side of the wound nearly the whole time of the operation. The proceeding is also liable to other great difficulties, as may be seen from a case reported by Masotti (*Dis. sul Aneurysma*, p. 53.), where the popliteal artery was so firmly united, and, as it were, confused with the vein, the nerve, the tendons of the neighbouring muscles, and the periosteum, that the cavity of the ham presented the appearance of an intricate mass of parts, not easily separable from one another. Lastly, the operation leaves a large deep wound, laying open the whole cavity of the ham, and followed by copious suppuration, sinuses, and necrosis of the heads of the femur and tibia. If the patient be not hurried into his grave by these affections, and even if the parts in the ham heal, he is almost always left with an incurable contraction of the knee, and perpetual lameness. Thus, Masotti (*Op.* cit. p. 17.) relates one case where the subsequent effect caused such destruction of the soft parts in the ham, that not a vestige of artery, vein, or sciatic nerve was left, and the patient remained all the rest of his life with a paralytic leg, and ulcers and fistulæ all round the knee. (*Scarpa on Aneurism*, p. 251—253. ed. 2.)

I shall now advert to a few facts in the history of surgery, which eventually led to the bold and successful operations performed at the present day, for the cure of aneurisms of the femoral and popliteal arteries. The earliest case, of which the particulars are recorded, amounting to a satisfactory proof that the lower extremity might be duly supplied with blood, notwithstanding the femoral artery had been tied high up in the thigh, is the example, related by M. A. Severinus, of a false aneurism of the thigh, about eight fingers' breadth below the groin, caused by a musket-ball wound. In this instance, Severinus tied the femoral artery above and below the aperture in it, and not only was the patient's life saved, but the use of the limb also preserved. (*Chirurgiæ Efficacis*, p. 2. *Enarratoria.*) The next authentic case of the ligature of the femoral artery, is that reported by Saviard, where Bottentuit, in 1688, tied this artery on account of a false aneurism, the result of a sword wound, at the inner and upper part of the thigh. The surgeons, called into consultation, were immediately convinced that the only thing to be done was to take up the femoral artery; but they were fearful lest the patient should perish of bleeding, ere the opening in the vessel could be found; and, in case the artery were secured, they apprehended that the obstruction of the circulation would be followed by mortification of the limb. The patient was therefore first prepared for his fate by the administration of the sacrament. A band was then applied round the upper part of the limb, and tightened by means of a stick, with which it was twisted, a piece of pasteboard being put under the knot, in order to render the constriction less painful. The tumour was then opened, the clotted blood extracted, and the opening in the artery detected by slackening the tourniquet. A curved needle, armed with a double ligature, was then introduced under the femoral artery, and one of the cords was tied above, and the other below, the wound in the vessel. Then follows a curious passage, showing the operator's judgment at that time, respecting the impropriety of interposing any cylinder of linen between the knot of the ligature and the artery, as some of the old surgeons at that time used to do, as well as a few of the moderns. "*On ne mit point de petites compresses sur le corps de l'artère au-dessus du nœud, comme font quelquesuns, parceque l'on jugea qu'il étoit d'une grande conséquence de lier très-étroitement une artère si considérable, ce que l'on n'auroit pas été sûr de faire en interposant la petite compresse,*" &c. For greater security, assistants, who relieved each other in turn, kept up constant pressure on the tied part of the vessel for twenty-four hours. In six weeks the patient recovered, and afterwards enjoyed such good health, that he went through several campaigns. (*Saviard, Nouveau Recueil d'Observations Chir. Obs.* 63. 12mo. Paris, 1702.)

Now, with respect to these two cases, it merits attention, that, though Heister, Morgagni, and others, endeavoured to explain the success, by supposing that each of the patients in question must have had a double superficial femoral artery in the limb operated upon, both Severinus and Saviard were wise enough to avoid making any such erroneous inference themselves. At a later period, Guttani laid bare the femoral artery, as it passed under Poupart's ligament; compressed it against the ramus of the pubes, by means of graduated compresses, retained with a firm roller; and thus obtained the speedy obliteration of the vessel, and cured an aneurism, which had been first injudiciously opened. (*De Externis Aneurysmatibus, Hist.* 15. 4to. Romæ, 1772.) In the same book is given the case of an inguinal aneurism, which, when it had continued three months, and become equal in size to a large fist, was attacked with gangrene, whereby the aneurismal sac was quickly destroyed, and the femoral artery obliterated for a considerable extent from the crural arch downwards. The sloughs were thrown off, however, and the ulcer had in a great measure healed, when the patient fell a victim to debility. (*Hist.* 17.) Here it is to be remarked, that, during the five weeks this man lived after the obliteration of the femoral artery, above the origin of the profunda, not only the circulation and life of the whole limb were preserved, but the auxiliary arteries, coming from within the pelvis, proved capable of limiting the progress of the mortification of the parts round the aneurism, and of commencing the healing process in a manner which raised great hopes of a cure. A similar fact is also recorded by Dr. Clarke. (*Duncan's Med. Comment.* vol. iii.)

These, and other cases which might be quoted, furnished ample proof of the efficiency of the anastomosing vessels in the support of the limb, though the femoral arttery had been tied, or obliterated in a very high situation.

Besides these facts, surgeons derived every encouragement to attempt the cure of popliteal aneurism, by the ligature of the artery above the tumour, from the elucidations given by Winslow and Haller, concerning the numberless inosculations which exist between the upper and lower articular arteries. Haller even drew the conclusion, that, if the course of the blood were intercepted in the popliteal artery, between the origins of the two orders of articular branches, such anastomoses would suffice for carrying on the circulation in the leg. And at length Heister, weighing the anatomical observations of Winslow and Haller, and the facts recorded by Severinus and Saviard, first proposed applying to popliteal aneurisms an operation, which, with the exception of those two cases, had until his time been restricted chiefly to aneurisms of the brachial artery. (*Dis. de Genuum Structurâ eorumque Morbis. Dis. Chir. Halleri,* t. iv.)

It was in Italy that the earliest operations were undertaken for the cure of popliteal aneurisms, by Guattani, or rather by a German surgeon, named Keysler, as would appear from a letter written by Testa to Cotunni. (See *Pelletan, Clinique Chir.* t. i.) The practice of tying arteries for the cure of aneurism was also adopted in Italy by Molinelli and Mazotti, at a period, when, in other countries, amputation was the measure to which the patient was always subjected. The success, obtained by these surgeons, soon led others to imitate them, and by degrees the practice of tying the femoral artery became common both in cases of aneurism and wounds; and from the observations of Heister (*Haller, Disp. Chir.* t. v.), Acrell (*Murray, de Aneurysm. Femoris*), Leslie (*Edin. Med. Comment,*), Hamilton (*B. Bell's Surgery,* vol. i.), Burschall (*Med. Obs. and Inq.* vol. iii.), Leber (*Dehaen, Ratio Medendi,* t. vii.), and Jussy (*Ancien Journ. de* (*Méd.* t. xlii.), it was proved, beyond the shadow of a doubt, that the circulation might continue in the limb, after the obliteration of the femoral artery, whether such obliteration were effected by direct pressure, or the ligature.

The exact period when the first operation of laying open the tumour and tying the popliteal artery was performed in England, is not, as far as I know, particularly specified. However, judging from the observations made on this practice in the writings of Pott (*Remarks on Palsy, &c.* 8vo. Lond. 1779), of Wilmer (*Cases and Remarks in Surgery,* 8vo. Lond. 1779), of Kirkland (*Thoughts on Amputation,* 8vo. Lond. 1780), and of others, it is clear that this method of treatment had been often done in this country earlier than the dates of those works, and, as would appear, with little or no success. The earliest attempt of this kind in France was made by Chopart in 1781 (*Roux Nouveaux Elémens de Méd. Opératoire,* t. i. p. 556.), about five and twenty years after the examples set by Guattani in Italy; but Chopart failed in his endeavours to repress the bleeding from the exposed cavity of the tumour, and was therefore obliged to amputate the limb. Subsequently to this attempt, the operation was undertaken by Pelletan in two instances, the terminations of which were successful: consequently, this surgeon may be regarded as entitled to the honour of having proved to his countrymen the possibility of curing the popliteal aneurism by laying open the tumour, and securing the artery in the ham.

The severity and frequent ill success of this method of operating I have already noticed, nor shall I repeat the objections to it. With respect to the Hunterian practice, the great peculiarities of which were tying the artery at some distance above the disease, and not opening the swelling at all, Richerand seems offended that Hunter's name should be affixed to an operation, which he conceives was in reality the invention of Guillemeau. Here we observe Ætius again puts in a prior claim, and with much more effect, because the method, of which he speaks, truly resembled Mr. Hunter's, inasmuch as the vessel is directed to be tied at some distance above the swelling, while Guillemeau only tied the artery close above the disease, and *opened the swelling, a serious deviation from the Hunterian practice.*

Guillemeau, a disciple of Ambrose Paré, having to treat an aneurism at the bend of the arm, the consequence of bleeding, exposed the artery above the tumour, tied this vessel, then opened the sac, took out the coagulated blood, and dressed the wound, which healed by suppuration. After more than a century, Anel, on being consulted about a similar case, tied the artery above the swelling, which was left to itself. The pulsation ceased, the tumour became smaller, and hard, and after some months no traces of the disease were perceptible.

In 1785, Desault operated in the same manner for a popliteal aneurism: the swelling diminished by one half, and the throbbings ceased; on the twentieth day it burst; coagulated blood and pus were discharged in large quantities; and the wound, after continuing a long time fistulous, at length healed. Towards the end of the same year, Hunter applied the ligature somewhat differently; instead of placing it close to the swelling, or directly above it, he put it on the inferior part of the femoral artery. (See *Richerand Nosogr. Chir.* t. iv. p. 98, 99. edit. 2.) Unquestionably Anel did, in one solitary instance, tie the brachial artery immediately above an aneurism at the bend of the arm, and effected a cure without opening the swelling (*Suite de la Nouvelle Méthode de guérir les Fistules lachrymales*, p. 251. Turin, 1714); but he did not think of applying the plan to the femoral artery, or draw the attention of French surgeons sufficiently to the matter, to make them imitate his operation: on the contrary, the method fell into oblivion, and was never repeated. With regard to Desault's operation, said to have been done in an earlier part of 1785 than Mr. Hunter's first operation, it is only necessary to say, that Desault tied the popliteal artery itself, while the grand object in Mr. Hunter's method was to take up the femoral artery, at a distance from the disease, and that it is this last mode alone, which has gained such approbation, and been attended with unparalleled success.

The French surgeons have not practised the Hunterian operation with the same degree of success with which it has been performed in England, and, consequently, they have often returned to the old method of opening the sac, &c. Even Boyer averred, a few years ago, his relinquishment of what he calls Anel's plan. (*Traité des Mal. Chir.* t. ii. p. 148.) But we shall not be surprised at this ill success, when we hear that some of them neglected, for a long while, the right principles on which ligatures ought to be applied to arteries, as explained by Dr. Jones in his work on hemorrhage. Even Baron Dupuytren, until a late date, adhered to the use of ligatures of reserve; while Boyer applied not less than four loose ligatures round the artery, besides two tight ones; and consequently a large portion of the vessel lay separated from its natural connexions, and irritated by these extraneous substances. Hunter's first operation nearly failed also on account of so many ligatures, none of which were tightened so as to cut through the inner coats of the artery, and thus promote its closure. (See HEMORRHAGE.) At length, however, Dupuytren, and several other distinguished surgeons in France, convinced of the inutility and danger of ligatures of reserve, totally discontinued their employment. (See *Leçons Orales de Clin. Chir.* t. iv. p. 531.) The following passage also shows the valuable reforms, which have taken place in France in the mode of tying arteries, and the treatment of aneurism. "The process generally employed at the present day," says Baron Dupuytren, "is that of Anel or Hunter. When an artery is tied in this plan, it is exposed, if possible, at a point far enough from the aneurism for the vessel to be perfectly healthy, and in a situation where it is superficial; so that the neighbouring veins and nerves may be more easily separated from it, and the ligature more conveniently tightened, in a proper degree. Another, not less important precept, is to preserve, above the wound, a sufficiency of collateral branches to keep up the circulation in the lower part of the limb after the operation, and to make the incision so that the ligatures may not be applied too near any large collateral vessels, particularly the superior ones, because their immediate proximity to the ligatures is one of the causes most to be apprehended of secondary hemorrhage. The incision should be extensive enough to let what is requisite be easily done to the artery, and *the fascia should be even more freely divided than the integuments*." (*Op.* et vol. cit. p. 516.) With reference to the operation for popliteal aneurism, *Rosenmuller's Chir. Anat. Plates*, part iii. tab. 8 and 9.; Scarpa's and Tiedemann's matchless engravings; Haller's *Icones*; *Manec, De la Ligature des Artères*, pl. 9. and 10.; and Elias Bujalsky, *Tabulæ Anat. Chir.* Petropol. 1828; deserve to be consulted.

Aneurisms of the Leg, Foot, Forearm, and Hand.

It is not long since doubts were entertained of the possibility of curing an aneurism at the upper part of the calf of the leg by tying the femoral artery in the middle of the thigh. (*Instituto Ital. di Scienze ed Arti*, vol. i. parte ii. p. 266.) The author, here referred to, was led by this uncertainty to have recourse in one instance to the severe method of laying open the tumour, in order to get at the vessel lower down. On this case, Scarpa makes some correct reflections: the operator (says he) assured himself, that, *on compressing the femoral artery at the upper part of the thigh, the tumour at the top of the calf ceased to pulsate; and that, when the compression was continued for some time, the swelling partly disappeared, and became softer.* It ought to have been evident, therefore, that the aneurism might have been cured by tying the trunk of the femoral artery, as described in the foregoing section. In Scarpa's work is a case, in which an aneurism at the bifurcation of the popliteal artery was cured by the ligature of the femoral artery. (See p. 541. ed. 2.) Mr. Hodgson has seen three aneurisms, situated at the commencement of the tibial arteries, cured by the same operation. (*On Diseases of Arteries, &c.* p. 437.) But, as Scarpa remarks, though the Hunterian operation answers in the cure of aneurism in the bend of the arm, and at the upper part of the calf of the leg, it is not so effectual for aneurisms situated on the back or palm of the hand, or the dorsum, or sole of the foot. The free communication, which the ulnar and radial arteries keep up with each other in the hand, and the tibial arteries have with each other in the foot, prevent the operation from succeeding, whether the brachial, or femoral artery, or one of the two large arteries of the forearm, or leg, be tied. In proof of this statement, Scarpa cites two cases of aneurism seen by himself; one on the instep, the kind of case seen also by Guattani; the other in the sole of the foot; and a third case of the same disease in the latter situation; all of which were found to be incurable by the ligature of the anterior tibial artery. (P. 311.) Scarpa thinks, however, that the operation of tying this vessel where it passes over the dorsum of the foot might succeed, if aided by compression, applied so as to stop the current through the other main channel; and he seems to approve of this practice, because the plan of tying the artery above and below the disease (which is the most certain means of cure) could not be done, without extensive incisions in the sole of the foot. In an aneurism at the lower part of the leg, Mr. Hodgson judiciously insists upon the prudence of tying the artery, as near as possible to the tumour, because the recurrent circulation, through the large inosculations in the foot, might still cause the swelling to enlarge, in consequence of the blood sent into the sac from the lower extremity of the vessel passing through the aneurismal cavity into branches arising from the artery between the aneurism and the ligature. (P. 438.) However, in one case of aneurism of the anterior tibial artery, Mr. H. Cline applied a ligature just above the tumour without success, and Sir Astley Cooper expressly recommends making an incision in the sac, and applying a ligature both above and below the swelling. (*Lectures, &c.* vol. ii. p. 63.) When an aneurism arises from the radial, ulnar, or interosseous arteries near the elbow, tying the brachial will suffice; but if the disease be lower down, the vessel from which it proceeds must be taken up near the swelling. (*Hodgson*, p. 393.) A case, strikingly illustrative of this truth, is recorded by Mr. Liston. J. M. P., aged nineteen, applied to him on the 28th of July, on account of an aneurism of the left radial artery, about the middle of the forearm, occasioned by a wound. The tumour was as large as a walnut, and so compressible that it could easily be made to disappear. Pressure was tried at first, with apparent benefit; but, as it did not succeed, the humeral artery was tied on the 8th of August, and with the effect of completely removing the tumour. On the eighteenth day afterwards, however, a small slough was detached from the cicatrix, and about three o'clock next morning a violent hemorrhage took place. Mr. Liston then deemed it necessary to lay open the sac, and tie the artery above and below the wound in it. (See *Edin. Med. Journ.* No. 90. p. 4.)

Scarpa mentions a case, where the dorsal artery of the thumb was wounded; but as the hemorrhage returned several times, and pressure failed in suppressing it, the surgeon took up the radial artery at the wrist. After cutting off this direct current of blood towards the injured vessel, pressure on the wound proved effectual. Three months afterwards, the patient having died, the radial artery was found impervious for three fingers' breadth below where the ligature had been applied, and the dorsal artery was likewise obliterated from the root of the thumb to the beginning of the palmar arch.

Mr. Todd has published a case, in which he cured a large aneurismal swelling of the posterior side of the forearm by tying the brachial artery. From the description, I conclude that the disease was an aneurism by anastomosis, as it is termed; but the particulars given by the author leave some doubt on this point. (See *Dublin Hospital Reports*, vol. iii. p. 135.)

The manner of exposing and tying the principal arteries of the leg and forearm will be described under the term Arteries.

Of Aneurisms high up the Femoral Artery.

Several facts, already specified in the preceding columns as having occurred many years before the operation of tying the external iliac artery was attempted, amounted to a full proof, that the circulation might go on in the lower extremity, notwithstanding the artery in the groin were tied, or obliterated. On this point, some of Guattani's cases were most decisive.

The ligature of the external iliac artery, for aneurisms of the femoral artery in the bend of the groin, has now been practised so frequently, and the instances of success are so numerous, that all doubt concerning the propriety and utility of the attempt has entirely ceased. The French, who evinced great backwardness in espousing the Hunterian method of operating for aneurisms, though it is decidedly one of the greatest improvements in modern surgery, at one period showed great reluctance to practise the operation of tying the external iliac artery. M. Roux, however, who was in London about twenty years ago, saw the thing done, and his testimony, no doubt, had considerable influence in quickening the adoption of this bold, but, on the whole, very successful measure, by his brethren in the capital of France. Still, as M. Roux remarks, " We cannot but blame the indifference with which the operation is mentioned in some of the latest French surgical publications. At this moment (1815) we can reckon twenty-three facts, relative to tying the external iliac artery, and, on fifteen of the patients, it has perfectly succeeded. In these twenty-three operations, I comprehend the two which were done in France; one at Brest, by Delaporte, and the other at Lyons, by Bouchet; cases the authenticity of which cannot be doubted. In the number of successful cases, is to be comprised Bouchet's operation, since the patient lived more than a year afterwards, and then died of the consequences of an inguinal aneurism of the opposite side.

" Sir A. Cooper alone had tied the external iliac artery six times before my journey to London, and during my stay there I saw him perform the operation once. Four of his patients were entirely well; one of the three others died, the thirteenth week after the operation, of the bursting of an aneurism of the aorta. At this period, the circulation in the limb had been re-established. I saw the limb after it had been injected, amongst Sir A. Cooper's anatomical preparations. Large and beautiful anastomoses existed round the pelvis, between the dilated branches of the internal iliac and femoral arteries. With respect to the sixth patient, the leg mortified, and the thigh was amputated without success. The seventh died of hemorrhage, which took place on the fourteenth or fifteenth day after the operation." (*Parallèle de la Chir. Angloise avec la Chir. Françoise*, p. 275, 276.) Sir Astley Cooper had tied the external iliac artery in nine cases (see *Lancet*, vol. ii. p. 44.); and the operation is now so common, that scarcely a week passes without some record of its performance in one part of the world or another.

The many facts exemplifying the propriety of this operation must have been highly gratifying to Mr. Abernethy, by whose judgment it was first suggested, and by whose enterprising hand it was first performed.

Mr. Abernethy was called upon on several occasions to take up the external iliac artery, and every one of these cases proved that the anastomosing vessels were fully capable of conveying blood enough into the limb below, and that a vessel even of this size could become permanently closed after being tied. Three of the operations in which Mr. Abernethy took up the external iliac artery, the very first examples of this practice, I was an eye-witness of, the cases having occurred at St. Bartholomew's Hospital at the time when I was an articled student there. (See *Abernethy's Surg. and Physiol. Essays, and Surgical Obs.* 1804; *Edin. Med. and Surg. Journal for January,* 1807.)

In Mr. Abernethy's first operation, performed in 1796, an incision, about three inches in length, was made through the integuments of the abdomen, in the direction of the artery, and thus the aponeurosis of the external oblique muscle was laid bare. This was next divided, from its connection with Poupart's ligament, in the direction of the external wound, for the extent of about two inches. The margins of the internal oblique and transverse muscles being thus exposed, Mr. Abernethy introduced his fingers beneath them to protect the peritoneum, and then divided them. Next he pushed this membrane, with its contents, upwards and inwards, and took hold of the external iliac artery with his finger and thumb. It now only remained to pass a ligature round the artery and tie it; but this required caution, on account of the contiguity of the vein to the artery. These Mr. A. separated with his finger, and introducing a ligature under the artery with a common surgical needle, tied it about an inch and a half above Poupart's ligament.

The following was the method, which Mr. Abernethy adopted in the second instance of tying the external iliac artery.

An incision, three inches in length, was made through the integuments of the abdomen, beginning a little above Poupart's ligament, and extending upwards; it was more than half an inch on the outside of the upper part of the abdominal ring, to avoid the epigastric artery. Here I may remark, that as the epigastric artery ascends obliquely inwards between the fascia transversalis and the peritoneum, near the internal border of the inner ring, the usual distance between which and the abdominal ring is an inch and a half, the place chosen by Mr. Abernethy for the incision did not in reality leave the epigastric artery unexposed to danger. The aponeurosis of the external oblique muscle was next divided, in the direction of the external wound. The lower part of the internal oblique muscle was thus uncovered; and the finger being introduced below the inferior margin of it and of the transversalis muscle, they were divided with the crooked bistoury for about one inch and a half. Mr. Abernethy now introduced his finger beneath the bag of the peritoneum, and carried it upwards by the side of the psoas muscle, so as to touch the artery about two inches above Poupart's ligament. He took care to disturb the peritoneum as little as possible, detaching it to no greater extent than was requisite to admit his two fingers to touch the vessel. The pulsations of the artery made it clearly distinguishable, but Mr. Abernethy could not put his finger round it with facility. In order to be able to do so, he was obliged to make a slight incision on each side of it. Mr. A. now drew the artery gently down, so as to see it behind the peritoneum. By means of an eye-probe, two ligatures were conveyed under the vessel; one of these was carried upwards as far as the artery had been detached, and the other downwards; they were firmly tied, and the vessel was divided in the interspace between them. (*Surg. Observ.* 1804.)

Mr. Freer, of Birmingham, who may claim the honour of having seconded Mr. Abernethy in this new practice, made an incision about one inch and a half from the spine of the ilium, beginning about an inch above it, and extending it downwards about three inches and a half, so as to form altogether an incision four inches and a half long, extending to the base of the tumour. The tendon of the external oblique being exposed, was carefully opened, and also the internal oblique, when the finger, being introduced between the peritoneum and transversalis, served as a director for the crooked bistoury, which divided the muscle. Avoiding all unnecessary disturbance, Mr. Freer separated the peritoneum with his finger, till he could feel the artery beating, which was so firmly bound down that he could not get his finger under it without dividing its fascia. The vessel having been separated from the surrounding parts, a curved blunt needle, armed with a strong ligature, was put under it, and tied very tight, with the intention of dividing the internal coats of the vessel. The operation led to a perfect cure. (*Freer on Aneurism,* p. 83. 4to. 1807.) Mr. Tomlinson, of the same town, was also an early performer of the operation: he applied only one ligature, and, of course, left the artery undivided; the event was completely successful.

The following is Sir Astley Cooper's mode of operating: A semilunar incision is made "through the integuments, in the direction of the fibres of the aponeurosis of the external oblique muscle. One extremity of this incision will be situated near the spine of the ilium, the other will terminate a little above the inner margin of the abdominal ring. The aponeurosis of the external oblique muscle will be exposed, and is to be divided throughout the extent and in the direction of the external wound. The flap, which is thus formed, being raised, the spermatic cord will be seen passing under the margin of the internal oblique and transverse muscles. The opening in the fascia, which lines the transverse muscle, through which the spermatic cord passes, is situated in the midspace between the anterior superior spine of the ilium, and the symphisis pubis. The epigastric artery runs precisely along the inner margin of this opening, beneath which the external iliac artery is situated. If the finger, therefore be passed under the spermatic cord, through this opening in the fascia, it will come into immediate contact with the artery, which lies on the outside of the external iliac vein. The artery and vein are connected together by dense cellular membrane, which must be separated to enable the operator to pass a ligature, by means of an aneurism needle, round the former." (See *Hodgson on Diseases of Arteries,* p. 421, 422.)

The foregoing incision, the convexity of which is turned outward and downward, I think, should extend from within and a little above the anterior superior spinous process of the ilium to above and a little within the middle part of Poupart's ligament, the exact point under which lies the internal ring, behind which the external iliac artery is to be found. As soon as the tendon of the external oblique muscle has been divided, the internal oblique and transverse muscles may be cautiously cut with the aid of a director; and then the fascia transversalis either divided in the same way, or torn through with the end of the scalpel, or director. Care must be taken to avoid the epigastric artery, which runs from the pubic side of the external iliac to the inner side of the incision. Baron Dupuytren, in performing the operation at the Hôtel-Dieu, in 1821, wounded the epigastric artery. (See *Averill's Operative Surgery*, p. 37.) The hemorrhage was so copious, that two ligatures were required. The patient afterwards died of peritonitis, which, in all probability, was brought on by the disturbance of the parts in the proceedings requisite for securing the ends of the wounded vessel. Hence, in operating according to Sir A. Cooper's plan, after pushing upwards the lower border of the internal oblique and transversalis, together with the spermatic cord, if the fascia transversalis is to be cut, and not torn, or if the inner ring, the opening in that fascia, is to be dilated, the requisite incision should be made with a probe-pointed bistoury in the direction towards the anterior superior spinous process of the ilium, and away from the epigastric artery. Mr. Guthrie has seen the epigastric artery divided in this operation, and two ligatures placed upon it without any inconvenience occurring. When such practice is adopted, he rates the importance of the accident much lower than I am inclined to do; for he observes, "I have reason to know that this artery is made a greater bugbear of, than there is any occasion for, in all operations on these parts. If the surgeon has unluckily divided it, either in this or any other operation, all that he has to do is to enlarge the incision, and tie both the divided ends; and I have no hesitation in saying, it will not be of any consequence, either in this operation, or one for hernia. If a man has been so unfortunate as to have a wound in his peritoneum, of a quarter or half an inch in extent, two ligatures on the epigastric artery, and a slight increase in the extent of the external incisions, add little or nothing to the danger, which only takes place in reality when the wound is closed up, and the artery is allowed to bleed internally." (*Guthrie on Dis. of Arteries*, p. 376.) While I approve of the practice of securing the two ends of the epigastric artery in a case of this description, the accomplishment of it would not be so easy as the delivery of the proper advice; and where the peritoneum is cut, as in examples of hernia, blood would be likely to be effused in the cavity of the peritoneum, before the ends of the vessel could be secured. In taking them up, also, a considerable disturbance and irritation of the parts would necessarily be produced. For such reasons, and on account of the generally fatal termination of a wound of the epigastric artery, I cannot but view this accident as a truly perilous one. The external iliac vein must never be included in the ligature, as such a proceeding would cause a dangerous interruption of the return of the blood.

Mr. Norman, of Bath, who has tried both modes of operating, found that proposed by Sir A. Cooper a more easy way of finding the external iliac artery, than the longitudinal incision practised by Mr. Abernethy. "The objection (says Mr. Norman) to Sir A. Cooper's mode of operating in cases where the tumour extends high up, is by no means well founded; for the lower part of the bag of the peritoneum, lying on the edge of Poupart's ligament, must in every case be exposed and detached, in order to get at the artery, which lies behind the posterior part of that membrane, and this is most easily effected by an incision in the direction of Poupart's ligament; whilst two thirds of the longitudinal incision are made on a part of the peritoneum, which lines the abdominal muscles, and the lower portion only of the incision reaches that part of the membrane which is to be separated. The consequences of this are, that the peritoneum is in much greater danger of being wounded, and that the probability of a hernia forming after the cure is much increased by the extensive division of the oblique muscles." (See *Med. Chir. Trans.* vol. x. p. 101.) These remarks are well founded, and they coincide with some observations, made many years ago by M. Roux, who, while he inclined to Mr. Abernethy's method, saw the disadvantage of letting the direction of the wound in this instance correspond to the course of the artery. Hence, after many trials on the dead subject, he laid down the rule, that the beginning of the wound should never be further than half an inch from, and a very little higher than, the anterior superior spine of the ilium, and that it should be carried very obliquely downwards, to the middle of Poupart's ligament. (See *Nouveaux Elémens de Méd. Op.* t. i. p. 747, &c.)

Mr. Todd, also, after repeated trials of Mr. Abernethy's and Sir Astley Cooper's methods on the dead subject, concluded that the plan, recommended by the latter, afforded the greatest facility of applying the ligature to the artery, because more room was obtained by it, and with less disurbance of the peritoneum, than in the other way. Where, however, it becomes necessary to apply a ligature to a higher part of the artery, in consequence of secondary hemorrhage, Mr. Todd conceives that Mr. Abernethy's method should be adopted. (See *Dublin Hospital Reports*, vol. iii. p. 92.)

In a case operated upon by Mr. Kirby, a hernia followed, in the situation where the abdominal muscles had been divided. (See *Cases with Obs.* p. 109. 8vo. Lond. 1819.)

In one case, Dr. Post found the peritoneum so thickened and diseased, that he could not raise it from the subjacent parts, and he was obliged to make an opening in it. The protruding viscera were then pushed back, and, with a needle, a ligature was introduced under the artery, the peritoneum being also included in the ligature. Notwithstanding the disadvantageous method of operating, and the return of pulsation in the swelling, the patient had so far recovered in three months, that he had regained the use of the limb. (See *American Med. and Phil. Reg.* vol. iv. p. 443.) Both the external iliac arteries of the same individual were tied in succession by Mr. Tait; one on the 8th of May, 1825, and the other on the 16th of April, 1826; and this with entire success, notwithstanding the peritoneum was wounded in one of these operations. M. Arendt also took up both the external iliac arteries in one patient, and, though there was only an interval of a week between the operations, the case had a very favourable termination. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 175.)

In one remarkable case, Mr. Newbiggin, by tying the external iliac artery, cured both an inguinal and a popliteal aneurism together. (See *Edin. Med. and Surg. Journal for Jan.* 1816, p. 71, &c.)

The many operations, which have now been done on the external iliac artery, impress me with a conviction, that, in subjects under a certain age, there is no reason to fear that the anastomoses will not generally suffice for the supply of the lower extremity. Out of twenty-five cases the particulars of which I formerly collected, there were only three in which the limb was attacked by gangrene. These three were patients of Sir A. Cooper, M. Bouchet of Lyons, and Mr. Collier. The proportion is not so much as one in eight. The three instances of gangrene were not all in the circumstances which permitted the event to be imputed to the anastomoses not having had sufficient time to enlarge, though perhaps Mr. Collier's case was such. On the other hand, we are to notice that Dr. Cole's patient was operated upon a few days after the wound, and yet the limb was duly supplied with blood, and did not become gangrenous. The same important facts were likewise exemplified in the remarkable case, where M. Velpeau was suddenly called upon to tie the external iliac artery, which had been accidentally wounded with a knife. Here, although there had been no preliminary dilatation of the collateral vessels, either by a trial of pressure, or by the presence of an aneurism, a ligature was at once put on the external iliac artery, with a perfectly successful result. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 175.) It appears therefore to me, that the occasional occurrence of gangrene cannot be admitted as a just reason for delay, until the collateral vessels have had time to enlarge. I believe, that in all aneurismal diseases, early operating is the best and most judicious practice. This was one principal cause, as Kirkland observes, which occasioned the bad success of the old surgeons in the treatment of popliteal aneurisms, and he foretold, many years ago, that operations for the cure of aneurisms would answer better, if not deferred so long as formerly. (See *Thoughts on Amputation, &c.* 8vo. Lond. 1780.) I join Kirkland in this sentiment, not without recollecting that all aneurisms are attended with a chance of getting well spontaneously in the course of time. I saw the inguinal aneurism which did so, under Dr. Albert, in the York Hospital; but as this is a rare incident, I do not believe that it ought to influence us against having speedy recourse to an operation. Besides, the cure by inflammation and sloughing appears to me to be attended in reality with more peril than a well executed operation, and, consequently, has less recommendations than many may imagine. Had not Dr. Albert's patient been a very strong man, he would certainly have fallen a victim to the extensive disease, which the bursting and sloughing of the tumour created. Thus, Delaporte's patient died of the mass of disease, which the tumour itself made; for it had been suffered to attain too large a size, so that, when it inflamed, the effects were fatal. (See *Richerand, Nosogr. Chir.* t. iv. p. 113. edit. 4.)

I believe Dr. Wilmot's observation is perfectly correct, that, if a comparison were made, between the operation of tying the external iliac artery and that of tying the artery in the thigh, we should find the recoveries after the first more frequent, in proportion to the number of times it has been done, than after common operations lower down. (See *Dublin Hospital Rep. &c.* vol. ii. p. 214.)

The greatest artery that conveys blood into the lower extremity, after the external iliac has been tied, is the gluteal; but besides it, the ischiatic, the obturator, and the external pudic, which anastomoses freely with the internal pudic, are important vessels in keeping up the circulation.

In one case, operated upon by Mr. J. C. Warren, the epigastric artery arose from the anterior and inner part of the sac, and gave origin to the obturator, while the circumflexa ilii originated from the outer part of the sac. All these vessels were greatly enlarged, and the epigastric rendered the necessary detachment of the external iliac very difficult. (See *New England Journ.*)

Some particulars of inguinal aneurisms, in which Sir A. Cooper, Mr. James, and Mr. Murray tied the aorta, will be hereafter noticed. (See Aorta.)

Rosenmuller's Chir. Anat.; Tiedemann's Tabulæ Arteriarum, Carlsruhæ, 1822; the plates in Scarpa's great work, *Sull Aneurisma Reflessioni, &c.* Par. 1804; *J. P. Manec, De la Ligature des Artères*, pl. ix.; and *Elias Bujalsky's Tabulæ Anat. Chir.* Petropol, 1828, tab. x. et xi., in illustration of the operation of tying the external iliac artery; all merit notice. Under the head of Arteries, additional instruction will be offered on the mode of taking up the external iliac artery.

Cases of Gluteal Aneurism cured by tying the Internal Iliac Artery.

The gluteal artery is large; from its situation, liable to wounds; from its size, subject to aneurism. Dr. Jeffray, of Glasgow, was consulted in a case, where the gluteal artery had been wounded. He urged the propriety of tying the vessel where it had been injured. This sensible advice was at first rejected; and when the friends at last consented, the operation was too late, as, while preparation was making for it, the tumour burst, and the patient expired in a few moments. Theden also mentions an instance, in which the gluteal artery was wounded in the dilatation of a gunshot wound, and the patient lost his life. (See *Scarpa on Aneurism*, p. 407. ed. 2.) Mr. John Bell, however, tied the gluteal artery in a case where it was wounded, and the patient was saved.

Mr. Stevens, surgeon in Santa Cruz, the gentleman who has proved the practicableness of putting a ligature round the internal iliac artery, informs us, that one of the first surgeons in London had a patient with glutæal aneurism. The tumour was large; allowed to burst; and the person bled to death. "I sincerely trust," says he, "that the following case may be the means of preventing such an occurrence in future. Maila, a negro woman, from the Bambara country in Africa, was imported as a slave into the West Indies in the year 1790. She was purchased for the estate Enfield Green; now the property of the heirs of P. Ferrall, Esq. I saw her first in the beginning of December, 1812. She had a tumour on the left hip, over the sciatic notch. It was nearly as large as a child's head, and pulsated very strongly. She could assign no cause for the disease. It had commenced about nine months before, with slight pain in the part; and had gradually increased to its present size. She was now much reduced, in great misery, and ready to submit to any operation." (See *Medico-Chir. Trans.* vol. v. p. 425.) Mr. Stevens had tied the internal iliac on the dead body, and believed that it might be done with safety on the living. The following is the account of the operation: "On the 27th of December, 1812, (says Mr. Stevens,) I tied the artery, in the presence of Dr. Lang, Dr. Van Brackle, Mr. Nelthropp, and Mr. Ford, the manager of the estate. An incision, about five inches in length, was made on the left side, in the lower and lateral part of the abdomen, parallel with the epigastric artery, and nearly half an inch on the outer side of it. The skin, the superficial fascia, and the three thin abdominal muscles, were successively divided; the peritoneum was separated from its loose connection with the iliacus internus and psoas magnus; it was then turned almost directly inwards, in a direction, from the anterior superior spinous process of the ilium, to the division of the common iliac artery. In the cavity, which I had now made, I felt for the internal iliac, insinuated the point of my forefinger behind it, and then pressed the artery betwixt my finger and thumb. Dr. Lang now felt the aneurism behind; the pulsation had entirely ceased, and the tumour was disappearing. I examined the vessel in the pelvis; it was healthy, and free from its neighbouring connections. I then passed a ligature behind the artery, and tied it about half an inch from its origin. The tumour disappeared almost immediately after the operation, and the wound healed kindly. About the end of the third week, the ligature came away, and in six weeks the woman was perfectly well."

This is the first example, in which the internal iliac was tied. The operation was not attended with much difficulty or pain, and not an ounce of blood was lost. Mr. Stevens had no difficulty in avoiding the ureter, which, when the peritoneum was turned inwards, followed it. Had it remained over the artery, he could easily have turned it aside with his finger. (See *Med. Chir. Trans.* vol. v. p. 422, &c.)

The woman enjoyed good health for ten years, and then died of an affection of the chest. The body was opened, and the internal iliac artery found impervious. Ths ischiatic artery had the appearance of a ligamentous cord, but the gluteal artery was pervious. The pelvis was then removed, brought from Santa Cruz, and deposited in the Museum of the Royal College of Surgeons in London. In the further examination of the parts, the ileo-lumbar artery was found to have arisen just above the part where the ligature had been applied, and consequently the external iliac had not been obliterated. The particulars of the dissection, as given by Mr. Richard Owen, are remarkably interesting. I shall only notice those circumstances, which strike me as peculiarly deserving of record. An incision being made into the common iliac, and continued down to the part where the internal iliac became contracted, it was found there to have become completely obliterated. In the state of a ligamentous cord, the internal iliac descended towards the ischiatic notch for the space of an inch, and then suddenly resuming its natural diameter, it again became pervious, and so continued for the extent of half an inch; the gluteal artery arising from the lower part of this space, a sacro-lateral vessel from about the middle, and the obturator artery from the upper part of it. The latter vessel was entirely obliterated; but the sacro-lateral was pervious, of the size of a crow-quill, and passed inwards to the second sacral foramen; whilst the gluteal artery received, close to its origin, two vessels, as large as the preceding, given off from the sacro-lateral artery. The ischiatic was impervious. The glutæal artery was of its natural size. An oblong tumour of the sciatic artery was detected, three inches and a half in length, between the tuberosity of the ischium and the great trochanter' doubtless the remains of the original disease. It was filled with dark-coloured, granular, not lamellated blood. From the ischiatic notch to the tumour, the artery was completely obliterated, its texture altered, and the remains of its cavity filled with indurated and partly calcareous matter. From the lower part of the swelling, the sciatic artery proceeded down the posterior part of the thigh, and was nearly as large as the femoral. Its calibre did not, however, correspond to its apparent magnitude, its coats being vastly thickened. It was obliterated for about the space of an inch below the sac, but became pervious again after receiving an anastomosing vessel from the profunda. Mr. Owen infers from several circumstances, which he specifies, that the aneurism was of the true kind. Amongst the things, highly deserving notice in this case, was the open space maintained by the collateral circulation in the trunk of the artery, between the ligature and the aneurism. (See *Med. Chir. Trans.* vol. xvi. p. 221, &c.)

A second instance, in which the internal iliac artery was tied, was some time ago communicated to the public. The operation was performed by Mr. Atkinson, of York, on account of a glutæal aneurism. The following are a few of the particulars: — Thomas Cost, aged 29, presented himself at the York County Hospital, April 29th, 1817. He was a tall, strong, active bargeman, not corpulent, but very muscular. He was enduring great pain from a large, elastic, pulsating tumour, situated under the glutæus of the right side; an obvious aneurism. It had existed about nine months, and was the consequence of a blow from a stone. In a consultation with Dr. Lanson and Dr. Wake, the necessity of the operation was determined upon, and it was performed on the 12th of May, without any material difficulty or interruption, except such as was the consequence of the division of, and bleeding from, the small muscular arteries. Having got command of the internal iliac artery within the pelvis, which, says Mr. Atkinson, required the complete length of the fingers to accomplish, it was tied. Sufficient proof of its being the identical artery was repeatedly obtained, by the pressure upon it stopping the pulsation, and causing a subsidence of the tumour. Dr. Wake, Mr. Ward, and all the pupils, were quite assured of the circumstance. The artery being then tied, the pulsation of the swelling entirely ceased. Some delay in placing the ligature arose from the needle not being sufficiently pliable; but, for future operations of this kind, Mr. Atkinson very properly recommends the ligature to be put round the artery by means of an instrument, resembling a catheter, the wire of which has a little ring at its extremity, and can be pushed out some way beyond the end of the tube.

The patient went on tolerably well for some time after the operation; the pulse never exceeded 130, and after a time sunk to 85 or 90. He became exhausted, however, partly by the discharge, and partly by hemorrhage, and died on the 31st of May, about nineteen days after the operation. In the dissection, the cavity, on the external part of the peritoneum, in the situation of the incision, was completely filled with coagulated blood. "The ligature, on moving a part of this (blood) with a sponge, readily followed it, and, without doubt, had been disengaged for some days." The internal iliac, which appeared to have been tied, had separated about an inch and a half from the bifurcation with the external iliac. By "separated," I conclude Mr. Atkinson means, that the upper part of the internal iliac was separated from the continuation of the same vessel. (See *Medical and Phys. Journ.* vol. xxxviii. p. 267, &c.) Although this gentleman has not given a very clear account of some part of the dissection, and he has also omitted to describe the place of his external incision, or the exact parts which he divided in the operation, yet I think that all the circumstances of the case, taken together, leave not the smallest doubt of the external iliac artery having been actually tied. The complete stoppage of the pulsation, as soon as the ligature was applied, and the testimony of several respectable practitioners, who were present, remove, indeed, all ambiguity. The profession is much indebted to Mr. Atkinson for this important communication, which was in some measure required, in order to confirm Mr. Stevens's similar case, as it is well known that some distinguished anatomists and surgeons in this metropolis formerly expressed strong doubts of the practicable nature of the operation.

The internal iliac artery has since been tied with success by an army surgeon in Russia, upon whom the late Emperor Alexander settled a pension, as a reward for the skill displayed in the treatment of the case. (See *Averill's Operative Surgery*, p. 39.)

The operation of tying the internal iliac was also performed by Mr. Thomas of Barbadoes, who sent the preparation of the parts to Sir Astley Cooper, and it is in the Museum of Guy's Hospital. (*Med. Chir. Trans.* vol. xvi. p. 230.) A fifth instance of the application of a ligature to the internal iliac artery took place in the practice of Mr. Hudson, of New York. (See *American Journ. of Med. Sciences* for Feb. 1828, art. v. p. 304.) A semilunar incision, seven inches in length, was made, with its convexity towards the ilium, from the vicinity of the umbilicus to that of the abdominal ring. After dividing the parietes of the abdomen, and tying some arteries which bled, the peritoneum was pushed upwards and inwards, and the handle of a scalpel passed under the trunk of the internal iliac artery, which was tied an inch below its origin. The patient recovered.

It is very justly observed by M. Velpeau, that the ligature of the internal iliac artery, with regard to its influence on the circulation, is in reality less serious than that of the external iliac, or even the femoral. In fact, it leaves undisturbed all the vessels appertaining to the corresponding limb, while the great pelvic arteries anastomose with one another so freely, that, when one is obliterated, an abundance of blood is promptly conveyed by the others to the organs which the obliterated one is designed to nourish. But the ligature of the internal iliac artery is dangerous in another point of view: first, on account of the difficulties in its performance; and secondly, on account of the unavoidable detachment of parts from one another which are connected together by a large quantity of loose cellular tissue, a texture in which inflammation and suppuration are disposed to spread to a great extent. (See *Velpeau, Nouv. Elém. de Méd. Oper.* t. i. p. 185.)

In a modern publication are given a few particulars of a case, which was supposed to be an aneurism of the glutæal artery, and cured by means of pressure, a light vegetable diet, gentle laxatives, and digitalis. (See *Trans. of the Fellows, &c. of the King's and Queen's College of Physicians in Ireland*, vol. i. p. 41. 8vo. Dub. 1817.) From the very imperfect account here given of the tumour, it is impossible to form any conclusion respecting its nature. Mr. Mayo also briefly mentions a case which was believed to be a false aneurism of the glutæal artery, and which got well without an operation. (*Outlines of Pathology.*)

Sandifort has recorded an instance of an aneurism of the internal iliac artery itself. (See *Tabulæ Anatomicæ, &c. Præcedit Obs. de Aneurysmate Arteriæ Iliacæ internæ, rariore ischiadis Nervosæ causa.* fol. Lugd. 1804.)

ANEURISM REQUIRING LIGATURE OF THE COMMON ILIAC ARTERY.

Professor Gibson had occasion to put a ligature round the common iliac artery, in an example of gunshot wound. "The patient lived fifteen days after the operation, and then died from peritoneal inflammation, and from ulceration of the artery, The circulation in the limb of the injured side was re-established about the seventh day after the artery had been tied." (See *American Med. Recorder*, vol. iii. p. 185.; and *Gibson's Institutes of Surgery*, vol. ii. p. 145. Philadelphia, 1825.)

In March, 1827, Dr. Mott took up the common iliac artery in a case of aneurismal tumour protruding considerably in the iliac region, and causing excruciating pain. Dr. Mott's incision, about eight inches in length, extended from the external abdominal ring, to one or two inches above the anterior superior spine of the ilium. The tendon of the external oblique muscle was divided, and also a part of the insertion of the internal oblique and transverse muscles. The operator then cautiously raised the peritoneum with his fingers, and detached it from the tumour and vessels, without doing it the slightest injury. The aneurismal dilatation was found to terminate about half way between the bifurcation of the aorta and the origin of the internal iliac trunk. The ligature was passed from the outside of the vessel, with the aid of an instrument invented by Drs. Parish and Hewson. The protrusion of the intestines rendered this part of the operation most difficult. The exact situation of the ligature was just below the bifurcation of the aorta, and at the side of the sacro-vertebral promontory. As soon as the ligature was tightened, the pulsation of the tumour ceased, its size was lessened, and the agonizing pain previously felt subsided. The limb having become cold, was wrapped in cotton and well covered, and, in little more than half an hour, its circulation and temperature were entirely restored. The operation was completely successful. In 1828, the operation of tying the common iliac artery was performed by Mr. Crampton, of Dublin; but the patient died of hemorrhage on the fourth day. In this case, the circulation, heat, and sensibility, which had been seriously interrupted in the limb for a time, were perfectly re-established, and every thing seemed to promise a favourable result, when, on a sudden, the ligature became displaced, and the patient died of internal hemorrhage. In the year 1833, the common iliac artery was taken up by Mr. Guthrie, for a tumour, supposed by him and some other surgeons to be aneurismal, but which proved to be of a medullary malignant character. The temperature of the limb after the operation diminished, but not much. It was constantly rubbed, day and night, and a hot brick and bottles of hot water applied to the feet. The tumour subsided directly.

After the ligature of the common iliac, the lower extremity is supplied with blood through the anastomoses of the internal mammary with the epigastric, of the uppermost lumbar arteries with the circumflexa ilii, or even the ilio-lumbalis; and, lastly, of the branches of the internal iliac of the sound side with those of the diseased one.

The unsuccessful application of a ligature to the femoral artery by Sir Astley Cooper and Mr. Anthony White, where the aneurism extended very high up the trunk, I have already noticed in the previous columns. The ligature of the aorta will be hereafter considered. (See Aorta.)

Aneurisms of the Brachial Artery.

Surgical writings contain many histories of aneurisms in the bend of the arm, produced by the puncture of the brachial artery in venesection, or caused by a deep wound inflicted at the bend of the arm, along the inner side of the humerus, or in the axilla. Such cases must indisputably be formed by effusion; but the blood extravasated may spread widely in the cellular tissue, so as to constitute a diffused false aneurism; or it may be confined in one mass, and be bounded by the adhesive inflammation, so as to form a circumscribed false aneurism. Morand and others found, that, along with aneurisms, caused by a wound of the brachial artery, the diameter of the vessel was sometimes enlarged through its whole length, above the seat of the tumour.

The proximate cause of these cases may invariably be traced to the solution of continuity in the two proper coats of the artery, and the consequent effusion of blood into the cellular substance. The effect is the same, whether from an internal morbid affection, capable of ulcerating the internal and fibrous coats of the artery, the blood be effused into the neighbouring cellular sheath surrounding the artery, which it raises after the manner of an aneurismal sac; or, the wound of the integuments having closed, the blood issue from the artery, and be diffused in the surrounding parts. The cellular substance, on the outside of the wounded vessel, is first injected, as in ecchymosis; the blood then distends it, and elevates it in the form of a tumour, and, the cellular divisions being destroyed, converts it at last into a firm capsule, or aneurismal sac. (*Scarpa*, p. 167.)

The circumscribed or the diffused nature of the aneurism, and the rapidity or slowness of its formation, depend on the greater or less resistance to the impetus of the blood, during the time of its effusion, by the interstices of the cellular substance surrounding the artery, and by the ligamentous fasciæ and aponeuroses, lying over the sac. The aponeurosis of the biceps muscle, being only half an inch broad, and situated lower than the common place for bleeding, cannot, at least in most cases, materially strengthen the cellular substance surrounding the artery, as is commonly supposed. (*Scarpa*, p. 168—170.) This author refers the greatest resistance to the intermuscular ligament, which, after having covered the body of the biceps muscle, extends over the whole course of the humeral artery, and is implanted into the internal condyle. This ligamentous expansion has a triangular shape, the base of which extends from the tendon of the biceps to the internal condyle, while the apex reaches upward along the inner side of the humerus towards the axilla, in the course of the artery. The humeral artery and median nerve, kept in their situation by the cellular sheath and this ligamentous expansion, run in the furrow formed between it and the internal margin of the biceps. (*Scarpa*, p. 171.) Many circumstances relative to the diffusion, circumscription, shape, &c., of brachial aneurisms, are explained by Scarpa by reference to this intermuscular ligament. Mr. Guthrie differs from Scarpa in imputing the diffused or circumscribed state of the aneurism after venesection to the aponeurosis of the biceps confining the blood or not. (*On Dis. of Arteries*, p. 333.) While aneurisms, from an internal cause, are not unfrequent in the aorta, thigh, and ham, they are exceedingly rare in the brachial artery; though a few such instances are recorded. (*Scarpa*, 174.; *Pelletan, Clinique Chir.* t. ii. p. 4.) Dupuytren, in noticing the great rarity of true aneurisms of the brachial artery, expresses his belief that Pelletan's is the only well authenticated instance of it. The cases, quoted by Scarpa from Paletta and Flajani, do not appear to him precise enough, and he takes the same view of those reported by Saviard and Hodgson. (See *Clinique Chir.* t. i. p. 265.)

The mode of distinguishing a wound of the brachial artery, in attempting to bleed, and the method of trying to effect a cure by pressure, are described in the article Hemorrhage. From the cases published by Mr. Cusack, it appears that the brachial form of aneurism to which pressure is most applicable, and in which it is most likely to effect a cure, is that of circumscribed false aneurism, unattended by inflammation either of the sac or of the surrounding parts. The pressure should be applied to the tumour alone, and not to the artery above; and it should be but slight, until the diminished pulsation and solidity of the swelling indicate that coagula fill the sac; for otherwise the aneurism will become diffused, as happened in one of Mr. Cusack's cases. (See *Dublin Journ. of Med. Science*, vol. i. p. 124.)

Anel was the first who tied the brachial artery, for the cure of the aneurism at the bend of the arm, in the same way that Hunter did the femoral, for the cure of aneurisms in the ham; viz. with one ligature above the tumour, without making any incision upon, or into, the sac itself.

The operation is performed as follows: — The surgeon having traced the course of the brachial artery, and felt its pulsations above the aneurism, may either cut down to the vessel immediately above the tumour, or much higher in the long space between the origins of the superior and inferior collateral arteries. The integuments are to be divided in the course of the artery, and also the fascia for the space of about two inches and a half. The surgeon, now introducing his left forefinger to the bottom of the wound, will feel for the hard cord, formed by the median nerve, and closely under, or at the side of which, is the artery within its sheath, which is to be opened. The surgeon should cut chiefly on the side next to the internal margin of the biceps, to avoid dividing any of the numerous muscular branches, which go off from the opposite side of the artery. He is then to separate the artery from the median nerve and the brachial veins, and with an eye-probe is to pass a ligature under the artery, and then tie it with a simple knot.

In the operation, it should always be recollected, that the median nerve lies in the lower part of the arm, on the inner side of the artery; and, therefore, that the instrument used for putting the ligature under the vessel, should be passed from within outwards, by which means the inclusion of the nerve will be avoided. (See *Boyer, Traité des Maladies Chir. &c.* t. ii. p. 193.)

The operation is well described by Mr. Hodgson: "The surgeon divides the integuments along the ulnar margin of the biceps muscle by an incision two inches and a half in length. The thin fascia, which surrounds the arm, will thus be exposed, and must be cautiously divided in the direction of the external wound. The artery lies immediately under the fascia, close to the margin of the biceps. The median nerve is situated on the ulnar side of the artery, which lies between its two venæ comites. The internal cutaneous nerve is also situated under the fascia in the middle of the arm, and lies near the ulnar edge of the median nerve. The cellular membrane, connecting these parts, is to be divided, until the coats of the artery are fairly exposed. ' This part of the operation will be effected with facility, if an assistant compress the artery above the wound, so as to stop the circulation through it, and render it in some degree flaccid. The point of an aneurismal needle is then to be introduced close to the ulnar, and brought out on the radial side of the artery, so as to avoid including the median nerve, or the veins which accompany the artery." (*On Diseases of the Arteries, &c.* p. 391.)

Sometimes the surgeon has a difficulty in discriminating the artery from the median nerve. When there is no pulsation perceptible in the artery, the firmer feel of the nerve is one of the best criterions. Indeed, after dividing the integuments, the hard cord felt under the fascia may be regarded, without any risk of mistake, as the median nerve. However, the best operators are sometimes perplexed. Thus, Dupuytren was operating on a patient who fainted, and, for more than a quarter of an hour, he remained doubtful which was the nerve, and which the artery, and he did not venture to tighten the ligature till the circulation had revived. (*Dupuytren, Clin. Chir.* t. i. p. 282.) And, in an other instance, after making an incision, two inches and a half long, in the course of the artery, above the bend of the elbow, he found the subcutaneous cellular tissue gorged with blood, and the cellular sheath, inclosing the median nerve and brachial artery, thickened and easily torn. A large vein lying across the artery was cut through. The fasciculus, composed of the artery and nerve, were next exposed, and an eye-probe passed under the guidance of a director beneath the artery, as Dupuytren supposed; but, on raising up the probe to ascertain what lay over it, severe pain was felt, followed by numbness in the track of the nerve. Dupuytren then, by very careful dissection, detached the nerve from the artery, to which he next applied a ligature. (*Op. et vol.* cit. p. 288.)

The importance of avoiding the inclusion of the median nerve in the ligature is great, not only with reference to paralysis, but to gangrene, which Dupuytren never knew follow the ligature of the brachial artery, except when that nerve had been tied together with it. (See *Clin. Chir.* t. i. p. 286.)

Whoever, says Scarpa, shall have the treatment of a *circumscribed* aneurism in the bend of the arm, will no longer, it is to be hoped, follow the method of those, who, supposing the tumour to be formed by the dilatation of the artery, used first to divide the integuments over the tumour, insulated the sac, and sought the vessel above and below the aneurism, in order to tie it in two places; and then endeavour to make the sac slough away. The operation is now reduced to the greatest simplicity, viz. tying the artery merely above the tumour. (See *Scarpa*, p. 358, 359.)

The ligature should be placed as near the aneurism as possible, the principal reason for doing it at a distance from the swelling in some other cases not being here applicable. (See *Harrison on the Arteries*, vol. i. p. 167.; *Guthrie on Dis. of Arteries*, p. 333. &c.) The correctness of Scarpa's recommendation of tying the artery only in one place above a circumscribed brachial aneurism is confirmed by the experience of Dr. Colles, who observes, "I have operated repeatedly, and with success, for the cure of brachial aneurism, in consequence of injury to the arteries in performing venesection. I have also frequently assisted others in operating for the same case, and with the same result; and I never yet found it necessary to open the aneurismal sac, or to apply more than one ligature round the artery, and which, I think, ought always to be tied as near as possible to the seat of the disease." (See *Harrison's Surgical Anatomy of the Arteries*, vol. i. p. 170. ed. 2.)

When the aneurism is *diffused*, and accompanied with violent inflammation and swelling of the whole arm, from the excessive distention of the clots of effused blood, Scarpa recommends the old operation of opening the tumour, and tying the artery at the bottom of the sac, above and below the wound made by the lancet. In this method, a tourniquet must be applied to the upper part of the arm, near the axilla; or if the limb be very painful and swelled, it is better to let an assistant compress the artery from above the clavicle, against the first rib. The incision having been made into the tumour, and the blood discharged, a probe is to be introduced into the puncture in the vessel, from below upwards, so as to raise the artery. This, being separated from the parts beneath, and the median nerve, for a small extent, is to have two ligatures put under it; one of which is to be tied above, the other below, the wound in the vessel. Then the tourniquet, or pressure, is to be taken off; and if there be no bleeding, the wound is to be brought together. (See *Scarpa*, p. 359.) With reference to this operation, Rosenmüller's Chir. Anat. Plates, part. ii. tab. 11.; Scarpa's plates; Tiedmann's beautiful engravings of the arteries; *Manec, De la Ligature des Artères*, pl. vi.; and *Camper's Demonstr. Anat. Pathol.* lib. i., are worth consulting.

From observations made by Mr. Harrison, a doubt may be entertained, whether, even in these circumstances, the adoption of the foregoing plan is always necessary. Indeed, he distinctly declares, that "in no case of *diffused* or circumscribed aneurism at the bend of the elbow have I seen it necessary to open the sac, or the artery below the tumour." "Brachial aneurism," says he, "which commences at the bend of the elbow, in consequence of a wound, is not always circumscribed. Sometimes the tumour extends up the arm between the biceps and triceps muscles, the fascia of the arm preventing its increase in a lateral direction. In one instance I saw the disease extend from the elbow nearly to the axilla. In this diffused aneurism, the surgeon must tie the brachial artery in the upper part of its course, and apply moderate compression along the aneurismal sac. This plan succeeded in the case to which I have alluded, and in which the operation was performed by Mr. Wilmot, in Jervis Street Infirmary; and a perseverance in moderate compression for some weeks, caused the total disappearance of the disease." (See *Harrison's Surgical Anat. of the Arteries*, vol. i. p. 169. ed. 2.) Still, exceptions to the preceding advice may present themselves. Thus the brachial artery has been wounded in venesection precisely at its bifurcation into the radial and ulnar branches. The brachial artery was tied close to the wounded part; but as the bleeding returned, it was secured a little higher up. Amputation was performed, and the patient lost his life. Here it was ascertained that a ligature could scarcely have been applied below the opening in the vessel, so near was this to the bifurcation; and perhaps the radial and ulnar arteries should have been secured. (See *Guthrie on Dis. of Arteries*, vol. i. p. 332.) While Baron Dupuytren expresses himself in favour of the preference, which should generally be given to a single ligature above the tumour in aneurism at the bend of the arm, he admits the possibility of this method failing, the pulsations being only temporarily suspended by it. In simple aneurism it will answer; in what he terms the arterioso-venous aneurism, or varicous aneurism, it will not stop the throbbings. (See *Clinique Chir.* t. i. p. 274.)

A high division of the brachial artery is well known to be a frequent occurrence. If, in consequence of this, two arteries should be exposed in the operation (see *J. G. Crosse, in Prov. Med. and Surg. Trans.* vol. v.), the surgeon should endeavour to ascertain by pressure, which vessel communicates with the wound, or sac, and apply the ligature accordingly; but, if the pulsation, or bleeding, cease only when both vessels are compressed, he will be justified in tying both. (See *Harrison's Surgical Anat. of the Arteries*, vol. i. p. 166. ed. 2.)

It was on the brachial artery that Mr. Lambert (*Med. Obs. and Inquiries*, vol. ii.) made the experiment of closing the puncture in the vessel by means of the twisted suture, under an idea that the plan would not, like compression, obliterate the arterial tube, and therefore that the risk of gangrene would be lessened. Now, although in the trial which was made, the bleeding was permanently stopped, Lambert was mistaken in supposing, that the previous state of the wounded part of the artery was preserved by the adoption of the twisted suture, instead of pressure, or the ligature. If ever a small puncture in an artery heal, so as to leave the tube of the vessel pervious, it is under the circumstances pointed out by Dr. Jones. (See Hemorrhage.) Had Lambert had an opportunity of examining the state of the vessel some time after the above operation, he would have found its canal obliterated; and had he known the freedom with which the collateral arteries anastomose with the recurrent arteries of the forearm, he would have known how to explain more correctly the re-establishment of the pulse. From the pulsation under the cicatrix having continued to be strong and natural in three examples of aneurism of the brachial artery after bleeding, which were cured by compression, Mr. Cusack infers, that the opinion hitherto entertained respecting the obliteration of the artery at the part wounded, is, in the majority of cases, erroneous. (See *Dublin Journ. of Med. Science*, vol. i. p. 124.) Such pulsation may not, however, be a satisfactory proof of the artery being pervious. I need merely add, that as the false idea of preserving the perviousness of the artery was the only foundation for Lambert's method, the practice ought never to be revived, as not affording equal security against hemorrhage to what is obtained by the ligature, or even compression.

Axillary Aneurisms.

Aneurisms occasionally take place in the axilla, and make it necessary to tie the subclavian artery. A question, here naturally presenting itself, is, whether the surgeon should attempt the operation in the early period of the disease, or wait till circumstances are urgent — the aneurism large and far advanced; the arm œdematous and insupportably painful, from the stretching of the axillary plexus of vessels; the patient worn out by suffering and loss of rest; and the tumour in danger of bursting? In all cases of aneurism, unquestionably, there is a certain chance of the disease getting well spontaneously; and one axillary aneurism, in a man in St. Bartholomew's Hospital a few years ago, had certainly disappeared of itself, as was proved by the account which the patient while living gave of his case, and by the obliteration of the artery, found on inspection after death. We may also find a few instances of subclavian aneurism being cured by Valsalva's treatment. (See *Pelletan, Clin. Chir.* t. i. p. 77.; *Cloquet in Archives*, 1834, t. vi. p. 511.)

I believe, however, we ought not to suffer our conduct to be too much influenced by the hope of events which are so unfrequent; and, from the observations which I have made on this subject, it is my decided opinion that the operation should never be delayed, so as to allow the tumour to acquire an immoderate size. The operation is always difficult; but the difficulty is seriously increased when the swelling has extended far towards the breast, and has become so large as to push the clavicle considerably upwards. The several examples, in which the subclavian artery has now been successfully tied, furnish abundant proof that the anastomoses are fully competent to the supply of the limb with blood. The plan, therefore, of delaying the operation long, with the view of allowing the inosculating arteries to enlarge, must be as questionable here, as in some other cases of aneurism, and, at all events, the maxim may be safely advanced, that, previously to the operation, the tumour should never be suffered to acquire an enormous size.

That the limb would receive an adequate supply of blood was well proved, even without the performance of the operation, by cases in which the axillary and subclavian arteries had been rendered impervious by disease; as, for instance, by the pressure of an aneurism of the aorta. (For an account of such facts, the reader is particularly referred to *Hodgson's Treatise on the Diseases of Arteries*, p. 111.; *Journ. de Médecine, by Corvisart, Leroux, and Boyer*, t. ii. p. 29.; *Corvisart, Essai sur le Maladies du Cœur*, p. 215.)

"In these cases," says Mr. Hodgson, "the only unusual circumstance, which was observed during the life of the patients, was the deficiency of the pulse at the wrist. The limbs were well nourished, although a considerable extent of the main artery (the subclavian) was obliterated even before it had given off any branches." (P. 47.)

This vessel was tied by Mr. Hall, in Cheshire, when it had been wounded with a scythe, and its ends exposed; the arm was preserved, though it remained somewhat weakened, which might be owing to the division of some large nerve. (See *J. Bell on Wounds*, p. 60. ed. 3.; and *Scarpa*, p. 372.) Mr. White, of Manchester, relates another instance of this vessel being tied, in the case of a wound; but mortification of the limb and death followed. Three of the nerves were found included in the ligature. (*Lond. Med. Journ.* v. 4.) In cases of wounds of the axillary, or any other large arteries of the extremities, the surgeon, before proceeding to apply a ligature, should first acertain the precise place of the wound in the artery; and, for this purpose, it may sometimes be proper, in certain wounds of the shoulder, to make an incision in the axilla so as to expose the injured part of the vessel; or, if circumstances do not forbid it, the external wound may be dilated, until the exact part, where the artery has been wounded, is discovered. In proof of the propriety of acting in this manner, and applying a ligature above and below the wound in the vessel, Scarpa quotes a case, in which such practice was successful on a patient under M. Maunoir of Geneva: the artery had been injured with a sabre near the head of the humerus; but, after the wounded part of the vessel had been traced, and secured in the way above suggested, the patient, a boy fourteen years of age, was saved from the dangers of hemorrhage, and recovered the use of his arm, as fast as this was possible, with the loss of the first phalanges of the three last fingers from gangrene. (See *Scarpa on Aneurism*, p. 412. ed. 2.; and *Journ. de Méd.* t. xl., *Mars*, 1811.)

There are two modes for operating for axillary aneurisms: one, by cutting below the clavicle, in order to take up the axillary artery itself; the other, by making the wound above the bone, for the purpose of securing the subclavian artery at the point where it emerges from behind the anterior scalenus muscle.

The first of these methods has been attempted by Desault, Pelletan, the late Mr. Keate, Mr. Chamberlaine, &c. In a case of wound of the axillary artery, Desault made an incision, six inches long, below the external third of the clavicle; two thoracic arteries cut were immediately tied; the two lower thirds of the great pectoral muscle were next divided with a bistoury guided on a director: a large quantity of coagulated blood was now discharged; and the artery was directly taken hold of, and tied, together with the brachial plexus of the nerves. The arm mortified, and the patient died. This case, we must agree with Scarpa, was not a fair trial of the operation, inasmuch as the inclusion of the plexus of nerves in the ligature was an improper measure, and must have promoted the occurrence of sphacelus. It seems also probable, from the account, that the vein was likewise tied; another serious and objectionable proceeding. Besides, it is worthy of notice, that the case was a wound of the axillary artery, attended with a copious effusion of blood in the cellular membrane. In all examples of this kind, gangrene is more readily induced, than when the case is merely a circumscribed aneurismal tumour. (See *Œuvres Chir. de Desault, par Bichat*, t. ii. p. 553.) As for Pelletan's example, it hardly deserves recital, because the operation in fact was not achieved. His colleagues objected to dividing the pectoral muscle; a random thrust was made with a needle and ligature; and the artery was not included. (See *Clinique Chir.* t. ii. Obs. 7. p. 49.)

In a case of axillary aneurism, which had actually burst, and the hemorrhage from which could only be stopped by pressing the artery against the first rib, the late Mr. Keate, surgeon-general, practised the following operation, which was attended with complete success. His plan was to take up the artery, above the diseased and ruptured part, in its passage over the first rib. Accordingly he made an incision obliquely downwards; divided the fibres of the pectoral muscle that were in his way; and, when he came to the artery, passed a curved, blunt-pointed silver needle, armed double, as he conceived, under the artery, and tied two of the ends. After a careful examination, finding that the artery pulsated below the ligature, he determined on passing another ligature higher up, and nearer to the clavicle: he, therefore, passed the needle more deeply, so as evidently to include the artery. In a few days the swelling of the arm began to subside, the wound suppurated, and the ligatures came away with the dressings. The arm afterwards recovered its feeling, and the patient regained, in a great measure, the entire motion of the shoulder, &c. (See *Med. Review and Magazine for* 1801.) This method is objectionable, inasmuch as it was a dive made with a needle, and attended with great danger of wounding and tying parts, which should be left undisturbed.

Mr. R. Chamberlaine, of Kingston, Jamaica, took up the axillary artery below the clavicle, in a patient who had an aneurism in the left axilla, occasioned by a wound with a cutlass on the 5th of October, 1814. On the 10th of January, the tumour had considerably increased, and was less compressible, than it had been when first seen by Mr. Chamberlaine. The operation was done on the 17th of January, 1815. "A transverse incision, of three inches in length, was made through the skin and platisma myoides, along and upon the lower edge of the clavicle, three fingers' breadth from the sternal end of that bone, and terminating about an inch from the acromion scapulæ. This incision divided a small artery, which was immediately secured. A second incision, of three inches in length, was also made obliquely through the integuments over the deltoid and pectoral muscles, meeting the first nearly in the centre. The cellular membrane and fat, lying between them at the upper part, were now removed. The next step consisted in detaching the clavicular portion of the pectoralis major, and taking away the fat and cellular membrane lying over the subclavian vessels. The artery was now brought into view, and its pulsations made it clearly distinguishable from the contiguous parts." After several ineffectual efforts, Mr. Chamberlaine succeeded in conveying a ligature under it, by means of an eye-probe, curved for the purpose, and the point of which was brought up with the aid of a pair of forceps. On the 22d of February, the wound was completely healed; the aneurismal tumour reduced to the size of a turkey's egg, and very solid; the arm smaller than its fellow, but its muscular power improving. (See *Medico-Chir. Trans.* vol. vi. p. 128, &c.) Mr. Chamberlaine expresses his conviction, that the operation would have been much facilitated, had he been furnished with the instruments described in Mr. Ramsden's work for passing the ligature under the artery: a still better invention, however, for passing a ligature under a deep artery, is the needle constructed by Mr. Weiss, surgeon's instrument-maker in the Strand. An engraving and description of this valuable instrument may be found in the *Edin. Med. and Surgical Journal*, No. 76.

Mr. Hodgson's directions for the performance of this operation are very clear: A semilunar incision through the integuments, which is to have its convexity downwards, and to begin about an inch from the sternal end of the clavicle, being continued towards the acromion for the extent of three or four inches, so as to end near the anterior margin of the deltoid muscle, without reaching into the space between the deltoid and pectoral muscle, in order to avoid wounding the cephalic vein. This incision will expose the fibres of the pectoral muscle, which are now to be divided in the direction and extent of the external wound. The flap is then to be raised, by dividing the loose cellular tissue, which connects the pectoral muscle to the parts underneath it. The pectoralis minor will now be seen crossing the inferior part of the wound; and, by introducing his finger between the upper edge of this muscle and the clavicle, the surgeon may feel the pulsations of the axillary artery. Here one of the cervical nerves lies above, but in contact with, the artery; the other nerves are behind it. In the dead subject, the axillary vein is situated below it: but, in the living, the vein is distended, and conceals the artery. The cellular tissue, connecting these parts, is to be separated by careful dissection, or by lacerating it with a blunt instrument. A ligature having been drawn under the artery with an aneurism needle, the ends of the cord are to be raised, and a finger passed down, so as to compress the part surrounded by the ligature. If the artery be included, the pulsation in the aneurism will immediately cease. This precaution is highly necessary, lest one of the cervical nerves should be tied, instead of the artery. (See *Hodgson on Dis. of Arteries, &c.* p. 362.)

When an aneurism extends a certain way inwards, or towards the trachea, the operation below the clavicle becomes impracticable; and it is now requisite to make the incision above that bone, and take up the subclavian artery at the point where it comes out from between the scaleni muscles, and lies on the flat surface of the first rib.

In the dead subject, without any tumour under the clavicle, this operation is easy enough; but in a living patient, and particularly in one whose neck is short, the difficulty is much increased, by a large axillary aneurism, for then the clavicle is sometimes so much elevated, and the artery lies so deeply, that a ligature can hardly be carried under it, without a particular needle for the purpose. This was the case in an attempt which I once saw made by Mr. Ramsden to tie the artery, and in which one of the cervical nerves, affected by the pulsation of the artery, was mistaken for it, and tied, so that the aneurism soon afterwards burst, and a fatal hemorrhage arose. Hence, the advice given by my friend Mr. Hodgson, always to operate in this case while the tumour is small, cannot be too well remembered. The direction, given by Mr. Liston, is also important; indeed, it is given by Mr. Hodgson, in relation to the operation below the clavicle, and may be said to apply to all operations for the cure of aneurism. It is one which Dupuytren always particularly insisted upon; namely, "before tightening the ligature, try the effect of compression with the fingers on the pulsation, as by taking this precaution (says Mr. Liston) I saved myself and my patient the pain of tying the nerve, which I got hold of in my first operation, in place of the artery." (*Lancet*, No. 195. p. 234.) The chief difficulty in the operation is that of passing the ligature round the artery; but, it may be done either with an ingenious needle, which Mr. Ramsden has described, and which is exactly similar in principle to Desault's *aiguille à ressort*, or with the still preferable instrument constructed by Weiss. Another very ingenious contrivance for tying deep arteries has also been recently proposed by Dr. Prevost, of Geneva. (See *Edin. Med. and Surgical Journ* No. 79.) The instruments used by Dr. Mott, when he took up the arteria innominata, will be presently noticed.

In order to avoid the inconveniences of the needles ordinarily used for conveying ligatures under deep arteries, Desault (says Bichat) invented "une aiguille à ressort," composed of a silver tube, or sheath, which was straight at one end, and bent at the other in a semicircular form. This sheath enclosed an elastic wire, the projecting extremity of which was accurately fitted to the end of the sheath, and perforated with a transverse eye. The instrument was passed under the artery, and, as soon as it had reached the other side of the vessel, the sheath was kept fixed, while an assistant pushed the elastic wire, which, rising from the bottom of the wound, presented the aperture or eye to the surgeon, who now passed the ligature through this opening. The wire was next drawn back into its sheath again, and the whole instrument brought from beneath the artery, by which means the ligature was conveyed under the vessel. (See *Œuvres Chir. de Desault, par Bichat*, t. ii. p. 560.) Another very ingenious method of passing the ligature under the artery, is that practised by Mr. Key; but, as the comprehension of it is difficult without the plate, I shall here merely refer to that gentleman's description of it. (See *Med. Chir. Trans.* vol. xiii. p. 10.)

The invention of the foregoing instruments makes a material diminution in the difficulty of taking up the subclavian artery from above the clavicle; nor can it be wondered, that without such assistance, the operation should have baffled even so skilful a surgeon as Sir A. Cooper. (See *Lond. Med. Review*, vol. ii. p. 200.)

The following example is the first, in which the operation of applying a ligature to the subclavian artery, from above the clavicle, was ever accomplished.

John Townly, a tailor, aged thirty-two, addicted to excessive intoxication, of an unhealthy and peculiarly anxious countenance, was admitted into St. Bartholomew's Hospital on Tuesday, the 2d of November, 1809, on account of an aneurism in the right axilla. The prominent part of the tumour in the axilla was about half as big as a large orange, and there was also much enlargement and distention underneath the pectoral muscle, so that the elbow could not be brought near the side of the body.

"The temperature of both arms," says Mr. Ramsden, "was alike, and the pulse in the radial artery of each of them was correspondent. After the patient had been put to bed, some blood taken from the left arm, and his bowels emptied, his pulse, which, on his admission, had been at 130, became less frequent; his countenance appeared more tranquil; and he experienced some remission of the distressing sensations in the affected arm: this relief, however, was of short duration."

The pulsation of the radial artery of the affected arm gradually became more obscure, and soon after either ceased, or was lost in the œdema of the forearm and hand. On the evening of the twelfth day, a dark spot appeared on the centre of the tumour, surrounded by inflammation, which threatened a more extensive destruction of the skin. A further postponement of the operation being deemed inadmissible, Mr. Ramsden performed it the next day in the following manner: a transverse incision was made through the skin and platysma myoides, along and upon the upper edge of the clavicle, about two inches and a half in length, beginning towards the outer border of the trapezius, and terminating about half an inch within the outward edge of the sterno-cleido-mastoideus muscle. "This incision divided a small superficial artery, which was directly secured. The skin, above the clavicle, being then pinched up, between my own thumb and finger, and those of an assistant, I divided it from within, outwards and upwards, in the line of the outward edge of the sterno-cleido-mastoideus muscle, to the extent of two inches.

"My object, in pinching up the skin for the second incision, was to expose at once the superficial veins, and, by dissecting them carefully from the cellular membrane, to place them out of my way, without wounding them. This provision proved to be useful, for it rendered the flow of blood during the operation very trifling comparatively with what might otherwise have been expected; and thereby enabled me with the greatest facility to bring into view those parts which were to direct me to the artery.

"My assistant having now lowered the shoulder, for the purpose of placing the first incision above the clavicle (which I had designedly made along and upon that bone), I continued the dissection with my scalpel, until I had distinctly brought into sight the edge of the anterior scalenus muscle, immediately below the angle, which is formed by the traversing belly of the omo-hyoideus, and the edge of the sterno-cleido-mastoideus; and having placed my finger on the artery, at the point where it presents itself between the scaleni, I found no difficulty in tracing it without touching any of the nerves to the lower edge of the upper rib, at which part I detached it with my finger nail for the purpose of applying the ligature.

"Here, however, arose an embarrassment, which (although I was not unprepared for it) greatly exceeded my expectation. I had learned, from repeatedly performing this operation, many years since, on the dead subject, that to pass the ligature under the subclavian artery, with the needle commonly used in aneurisms, would be impracticable; I had, therefore, provided myself with instruments of various forms and curvatures to meet the difficulty, each of which most readily conveyed the ligature underneath the artery, but would serve me no farther; for, being made of solid materials, and fixed into handles, they would not allow of their points being brought up again at the very short curvature, which the narrowness of the space between the rib and the clavicle afforded, and which, in this particular case, was rendered of unusual depth, by the previous elevation of the shoulder by the tumour.

"After trying various means to overcome this difficulty, a probe of ductile metal was at length handed me, which I passed under the artery; and bringing up its point with a pair of small forceps, I succeeded in passing the ligature, and then tied the subclavian artery at the part where I had previously detached it for that purpose. The drawing of the knot was unattended with pain, the wound was closed by the dry suture, and the patient was then returned to his bed." (See *Practical Obs. on the Sclerocele, &c. to which are added four Cases of Operation for Aneurisms*, p. 276, &c.)

Immediately the artery was tied, the pulsation of the swelling ceased; the arm of the same side continued to be freely supplied with blood, and was even rather warmer than the opposite arm; the operation, which was severe from the length of time it took up, was followed by considerable indisposition; the patient died about five days after its performance: after the artery had been tied, the œdema of the arm and the aneurismal tumour partly subsided; and on examination after death, nothing but the vessel was found included in the ligature.

In Mr. Ramsden's publication are descriptions of instruments which will be of great service to any future performer of this operation. The chief one is a needle, resembling that which was invented and used by Desault, and of which I have already endeavoured to give an idea. By means of this or other instruments already specified, I conceive, that the main difficulty of the operation will in future be avoided. Had Mr. Ramsden had its assistance, his patient would have been detained a very little time in the operating theatre, and the event of the case might have been completely successful. Having witnessed all the circumstances of the case, the inference that I drew from them was, that, if the operation could have been done in a moderate time, which now seems practicable with the aid of some kind of aiguille à ressort, or even without it in most examples, the case in all probability would have ended well. The preceding case is particularly memorable, as being the first instance in which the subclavian artery was scientifically tied, without any random thrust of a needle, and without the inclusion of any part besides the artery in the ligature. It furnished encouragement to repeat the experiment;

held out the hope, that axillary aneurisms might be cured as well as inguinal ones; and confirmed the competency of the anastomosing arteries to nourish the whole upper extremity, when the subclavian is tied where it emerges from behind the anterior scalenus muscle.

In the year 1811, the subclavian artery was tied in the London Hospital, in a case of axillary aneurism, by Sir W. Blizard, who found no difficulty in getting the ligature under the artery, with a common aneurism-needle. A single ligature was applied. At first, hopes of recovery were entertained; but the patient, who was old and debilitated, afterwards sunk, and died on the fourth day. (See *Hodgson's Treatise*, p. 375.)

In the year 1815, Mr. Thomas Blizard tied the subclavian artery in the same hospital. The case was an aneurism in the left axilla, and, like all the other examples of this kind upon record, was attended with great pain in the tumour and limb. There was no pulse in the left radial artery, though there was scarcely any difference in the temperature of both arms. "An incision, about three inches in length, was made through the integuments at the root of the neck, on the acromial side, and parallel with the external jugular vein. The platysma myoides being divided, the cellular membrane was separated with the finger, until the pulsation of the subclavian artery was felt where the vessel passes over the first rib. The finger being pressed upon this part of the artery, the cellular sheath investing it was carefully opened with the point of a knife. A ligature was then conveyed underneath the artery, by means of a common aneurism-needle, with the greatest facility." As soon as the ligature was tied, the pulsation in the tumour ceased. On the second day after the operation, the left arm began to have more feeling, and was as warm as the right. However, difficulty of breathing, twitchings, delirium, &c., afterwards ensued, and the patient died on the evening of the eighth day, previously to which event the ring and middle fingers turned black. On opening the body, the pericardium exhibited the effects of a high degree of inflammation, and the heart was covered with flakes of lymph, its posterior surface being of a deep red colour. The inner membrane of the ascending aorta was of a bright scarlet hue, much diseased, and studded with white patches. A reddish appearance was also noticed in the lining of the right cartoid, left subclavian, and even the abdominal aorta. The boundaries of the aneurismal tumour were in a state of sphacelation. These are all the circumstances which I wish here to notice; but more particulars may be perused in Mr. Hodgson's work, p. 602.

In some cases upon record, no difficulty was experienced in passing the ligature under the artery with a common aneurism-needle, a circumstance which must have depended upon the space between the clavicle and the first rib having been less deep in these instances than the two which fell under my own observation, or in others which occurred in the practice of Dr. Colles, Sir Astley Cooper, and Mr. Liston. (See *Lond. Med. Review*, vol. ii. p. 200.; and *Edin. Med. and Surg. Journal, January*, 1815, No. 64.) In Mr. Key's case, "the depth of the angle in which the artery was enclosed, rendering it impossible to pass a ligature under it, about three quarters of an inch of the clavicular portion of the sterno-mastoid was divided, which afforded sufficient room, and rendered the concluding part of the operation easy; the artery became readily exposed to view, and an armed aneurismal needle was passed with facility under it." (*Med. Chir. Trans.* vol. xiii. p. 5.) It is an observation made by Dupuytren, that in persons who have long necks, the subclavian artery is more superficial than in others whose necks are short. The size and situation of the tumour will also make a considerable difference; for if it be large, and placed a certain way towards the shoulder, it may raise the clavicle a good way from the first rib, and increase the difficulty of the operation.

In Dr. Colles's first case, the artery was tied before it reached the scaleni muscles, as the tumour, which was in the right subclavian artery, extended from the sternal origin of the sterno-mastoid muscle along the clavicle, a little beyond the arch of that bone, and rose nearly two inches above it, in a conical form, the apex of the cone being situated at the outer edge of the foregoing muscle. After a tedious dissection, it was found, that only a quarter of an inch of the artery was sound, and on this portion the ligature was placed. Great difficulty was encountered in passing it round the artery, and the pleura was supposed to have been slightly wounded. Before tightening the ligature, the breathing became laborious, and the patient complained of oppression about the heart. These symptoms, indeed, were so violent, that it was judged prudent not immediately to tighten the ligature. On the fourth day, however, the artery was constricted, when the pulse at the wrist ceased, the patient not seeming to suffer much from what had been done. The patient then went on pretty well till the ninth day, when he was seized with a sense of strangling, and pain about his heart; and becoming delirious, died in nine hours after the beginning of this attack. On dissection, the aorta was found diseased, and the disease extended into the subclavian artery.

In another instance, Dr. Colles tied this vessel at the point where it emerges from between the scaleni muscles, without any particular difficulty. The operation, however, was soon followed by a train of severe symptoms, delirium, and mortification; the patient dying on the fifth day. (See *Edin. Med. and Surg. Journ., January*, 1815.)

The first case in which complete success attended the operation of tying the subclavian artery, where it first comes from behind the anterior scalenus muscle, was that under the care of Dr. Post, of New York. The patient was a gentleman, with an aneurism in the left axilla. Dr. Post performed the operation on the 8th of September, 1817, in the following manner:—"An incision, commencing at the outer edge of the tendon of the mastoid muscle, was carried through the integuments about three inches in length, in a direction deviating a little from a parallel line with the clavicle. This divided the external jugular vein, the bleeding from which required a ligature for its suppression; and, in proceeding with the operation, three or four arterial branches were cut, which it was also necessary to secure. The subclavian artery was then sought immediately on the outside of the scaleni muscles, and was easily laid bare. Passing over the artery at this place, in contact with it, were three considerable branches of nerves, running downwards towards the chest, from the plexus above. These were separated, and a ligature passed under the artery, with great facility, by the instrument, well adapted to this purpose, invented by Drs. Parish, Hartshorn, and Hewson, of Philadelphia. On tying the ligature all pulsation ceased in the limb." In the afternoon, the temperature of the limb was observed to be rather higher than that of the other arm. On the 17th of September, the aneurismal tumour burst, and about three ounces of dark coagulated blood were discharged. On the 26th, the ligature came away from the subclavian artery. Oct. 11. the wound was entirely healed; and, on the 16th of the same month, the patient required no further attendance, his only complaints being now a little occasional pain in the fingers, and a superficial sinus at the part where the tumour burst. (See *Med. Chir. Trans.* vol. ix. p. 185, &c.)

In Europe, the first axillary aneurism cured by taking up the subclavian artery from above the clavicle, was that in which Mr. Liston was the operator, on the 3d of April, 1820. The particulars of the case prove the risk there always is of tying one of the axillary nerves, instead of the artery, unless great caution be employed; and, in fact, Mr. Liston himself first passed the ligature under a nerve, and would have tied it, had he not wisely tried what effect constricting the included part would have upon the pulsation of the tumour; a criterion that was never neglected by Dupuytren in operations for aneurism. As the subclavian artery seemed diseased at the point where it emerged from behind the anterior scalenus, Mr. Liston cautiously divided this muscle to about its middle, so as not to injure the phrenic nerve. At length, with the aid of an aneurism-needle, he passed a strong round silk ligature under the artery, and, laying hold of the loop with a small hook, withdrew the needle. In consequence of the great depth of the artery, the knot could not be made with the fingers; but, with the assistance of a kind of forceps, each extremity of which had a little notch in it, the business was accomplished. (See *Edin. Med. and Surgical Journ.* No. 64.)

Several other successful operations of this kind have subsequently been done by English surgeons. One by Dr. Gibbs, in the General Naval Hospital of St. Petersburgh (see *Med. Chir. Trans.* vol. xii. p. 531.); another by Mr. Bullen, in the Lynn Dispensary (see *London Med. Repository for Sept.* 1823); a third by Mr. Wishart at Edinburgh (see *Edin. Med. and Surg. Journ.* No. 78.); a fourth by Mr. Key, in Guy's Hospital (see *Med. Chir. Trans.* vol. xiii. p. 1.); a fifth by Mr. B. Cooper, in the same establishment; and a sixth by Dr. Hobart, of Cork (see *Edin. Med. and Surgical Journ.* No. 126. p. 48.)

When the subclavian artery (says this gentleman) has emerged from behind the anterior scalenus muscle, it passes obliquely over the flat surface of the first rib, with which it is in immediate contact. The cervical nerves are situated above and a little behind the artery: the subclavian vein passes before it, and underneath the clavicle. If the finger be passed down the acromial margin of the anterior scalenus muscle, the artery will be found in the angle, formed by the origin of that muscle from the first rib. The shoulder being drawn down as much as possible, the skin is to be divided, immediately above the clavicle, from the external margin of the clavicular portion of the mastoid muscle, to the margin of the clavicular insertion of the trapezius. I think, with Mr. Hodgson, that no advantage whatever can be gained by cutting the clavicular attachment of the sterno-cleido-mastoideus. The exposed fibres of the platysma myoides are now to be carefully divided, without wounding the external jugular vein, which lies immediately under them, near the middle of the incision, and should be detached, and drawn towards the shoulder with a blunt hook. The cellular membrane, in the middle of the incision, is then to be cut, or separated with the finger, until the surgeon arrives at the acromial edge of the anterior scalenus. He passes his finger down the margin of this muscle, until he reaches the part where it arises from the first rib, and in the angle, formed by the origin of the muscle from the rib, he will feel the artery. The ligature is now to be conveyed under the vessel with an aneurism-needle, or that recommended by Desault. (*Hodgson on Diseases of Arteries, &c.* p. 376, &c.)

In 1819, Baron Dupuytren took up the left subclavian artery in the second part of its course, for the cure of an axillary aneurism, following a stab. This eminent surgeon used to consider this vessel as having three different portions; the first, extending from its origin from the aorta to the point where it passes between the scaleni; the second, from its entrance between the scaleni to the point of its quitting the interspace between them; the third, from the latter point to the upper surface of the first rib. This third portion of the course of the subclavian artery, which in individuals whose necks are long and slender, and whose shoulders are low and thin, is not far beneath its skin, is, on the other hand, very deeply placed in persons whose necks are thick and short, and whose shoulders are covered with a good deal of flesh. In particular, this portion of the vessel is also deeply seated, when the clavicle is pushed up by a tumour in the axilla. Dupuytren's patient was in these latter circumstances; and besides the difficulty which they created to the ligature of this portion of the artery, Dupuytren reckoned that he should have had a good deal of trouble in separating the artery from the brachial plexus of nerves, which, however, in this situation, in reality lie above the vessel, the lowermost one alone lying close above it. Now, Dupuytren conceived that the second part of the course of the artery presented the advantage of the vessel passing alone between the scaleni, entirely separated from the subclavian vein, which ran in front of the anterior scalenus muscle, and also from the brachial plexus, the nerves of which lay backwards and outwards; consequently, by taking the anterior scalenus muscle as a guide, he judged that the artery might be tied, without risk of including any nerve in the ligature.

Governed by these reflections, Dupuytren made an incision on the left side, and at the lower part of the neck, from above downwards, and from within outwards. By this the skin, platysma, and subcutaneous cellular tissue were divided, together with three small vessels, which were immediately secured. In the continuation of the operation, the cellular tissue and absorbent glands contiguous to the artery and brachial plexus were arrived at.

The external border of the anterior scalenus was sought for, and this muscle completely cut through near its insertion, with the aid of a probe-bistoury. The artery was now exposed, and its pulsation readily stopped by the pressure of a finger passed to the bottom of the wound. A silver director, bent in the form of a quarter of a circle, was passed under the artery; and an eye-probe, armed with a ligature composed of three silk threads, conducted along the groove of the director, and withdrawn from the opposite side. Care was now taken to ascertain that the ligature was really under the artery by pulling at each end of it, and at the same time placing the forefinger on the vessel above it. In this manner it was found that the pulsation of the artery was completely stopped. This proceeding, repeated several times, was observed not to give the least pain; a proof that no nerve was included in the ligature. The artery was now tied; the wound brought together; and the limb placed on a pillow, and covered with bags filled with warm sand. This case proved successful. By the sixty-eighth day the tumour was reduced to one fifth of its original size. The heat, sensibility, and muscular powers of the limb were entirely re-established. In it, as in all limbs, whose principal artery has been tied, the arteries did not pulsate, though blood circulated freely through them. This fluid in passing through numerous and minute anastomoses, from the upper to the lower portion of the limb, seemed to Dupuytren to be no longer within reach of the power of the heart. Between two and three years after the operation, an abscess formed in the axilla and burst. Dupuytren enlarged its opening, and a great deal of pus, blended with old coagula, was discharged. This was soon followed by a perfect cure. (See *Leçons Orales de Cliniq. Chir.* t. iv. p. 524—535.) The reasons assigned by Dupuytren for choosing this method of operating, appear to me not so good as one, which, I believe, is the only valid ground for taking up the subclavian in the second part of its course, viz. the extension of the tumour too far inwards to admit of the ligature being applied at the point, where the artery emerges from behind the anterior scalenus, close behind the tubercle of the first rib. This point can always be reached with facility, by tracing the outer edge of that muscle downwards, whatever may be the conformation of the neck or the height of the shoulder. The phrenic nerve, be it remembered, would also be considerably exposed to injury in Dupuytren's method, which therefore seems to me eligible only under the circumstances already specified.

With respect to tying the subclavian artery on the tracheal side of the scalenus, I have stated, that it was performed by Dr. Colles, and the event fatal. Descriptions of the operation may be found in Mr. Hodgson's work, p. 382. When I consider the manner in which the subclavian artery, before it passes behind the anterior scalenus, is surrounded by parts of great importance, I can scarcely bring my mind to think, that the measures, requisite for taking up the vessel in this situation, will ever leave the patient much chance of recovery. "Between the aorta and scaleni muscles (says Mr. A. Burns), the subclavian arteries are connected with several important vessels and nerves. They are in the vicinity of the nervus vagus, of the recurrent laryngeal nerve, of the sympathetic nerve, of the phrenic nerve, and the subclavian vein; and, on the left side, the subclavian artery is intimately connected with the termination of the thoracic duct. These parts are all grouped together in a very narrow space, and the perplexity of their dissection is further increased by the interlacement of the different nerves with one another. The natural connections of these parts are best shown by merely raising the external extremity of the sterno-mastoid muscle. If this be done, the nervus vagus will be brought into view, lying on the forepart of the subclavian artery, almost directly behind the sternal end of the clavicle; and, exactly opposite to the nervus vagus, but behind the artery, the lower cervical ganglion of the sympathetic nerve will be brought into view. The recurrent nerve, on the right side, hooks round the subclavian artery, and, in its course towards the larynx, ascends along the tracheal side of the sympathetic nerve. On the left side, it twines round the arch of the aorta, and, in mounting upward, is interposed between the subclavian artery and œsophagus. The subclavian vein lies anterior to the artery, and, in the collapsed state, sinks nearer to the thorax;" but, when distended in the living body, it overlaps the artery. The thoracic duct enters the subclavian vein about the eighth of an inch nearer to the acromion than the point where the internal jugular vein empties itself into the subclavian vein. The termination of the thoracic duct is situated between the sternal and clavicular portions of the sterno-mastoid muscle. (*A. Burns, on the Surgical Anatomy of the Head and Neck*, p. 28.)

Axillary aneurisms are sometimes attended with fluctuation, in consequence of the blood becoming effused in the cellular tissue, and the pulsation in the deeper part of the swelling is then concealed. In such a case, Dupuytren once suspected the disease to be a chronic abscess, and made an exploratory puncture into the swelling; but a gush of blood made him promptly withdraw the knife and close the wound. The puncture healed up. Dupuytren wished to have tied the subclavian artery, but he was opposed by one of his colleagues; and, in the end, a point of the skin sloughed, hemorrhage took place, and the patient died. (*Clin. Chir.* t. iv. p. 520.)

A case, in which an axillary aneurism, unattended with pulsation, was punctured, and the child bled to death, is recorded. (See *Med. Chir. Journ.* vol. iv. p. 78.)

For anatomical views of the parts concerned in the operation of taking up the subclavian artery, consult *Rosenmüller's Chir. Anat. Plates*, part ii. tab. 8 and 9.; Tiedeman's and Scarpa's beautiful engravings; *Manec, Sur la Lig. des Artères;* and *Tabulæ Anat. Chir.* ed. Elias Bujalsky, Petropol. 1828, tab. vi. et vii.

Some valuable anatomical remarks, in relation to the operation, are given by Mr. A. Burns. (*Surgical Anatomy of the Head and Neck*, p. 28, &c.)

Mr. Guthrie observes, whenever an aneurismal tumour in the neck is accompanied by an alteration of the sterno-clavicular articulation, the case is clearly unfit for any operation, except that suggested by Brasdor, even if any operation at all be admissible. (See *Guthrie on the Arteries*, p. 397.) The same, he adds, may be said of any case of aneurismal swelling, either internal or external to that articulation, in which the stethoscope, applied on the sternum in the course of the arteria innominata, or the arch of the aorta, indicates disease. A swelling at the root of the carotid is more likely to be an aneurism of the arch of the aorta or of the innominata, than of the carotid itself, and the stethoscope will remove all doubt. In one case of subclavian aneurism, where the tumour left no room for the application of a ligature on the tracheal side of it, and where there was great reason to suspect that the arteria innominata was itself enlarged, Baron Dupuytren took up the axillary artery on the 12th of June, 1829, in the Hôtel Dieu. The patient was placed in the recumbent posture, with the right arm raised from the side. An incision was begun near the inner end of the clavicle, two finger-breadths below it, and extended outwards nearly parallel to that bone for about three inches. The fibres of the great pectoral muscle, and then the upper third of the lesser pectoral, were divided. The axillary artery having been next separated from the vein and brachial plexus of nerves, a ligature was passed under it, with an eye-probe, and tightened, the doing of which occasioned no pain. In the course of the operation, which lasted thirty-five minutes, several arterial branches were cut and secured. Immediately after the axillary artery had been tied, the pulsations of the tumour became stronger and irregular, but soon returned to their former strength; simple dressings were applied to the wound, and a bladder of ice to the swelling. An anodyne draught was also exhibited ten hours after the operation; the pulse was strong, and under 90 in the minute. Some blood was now taken from a vein in the arm. On the 13th of June, the patient was feeble, and complained of restlessness and want of sleep. The pulsations in the tumour had not sensibly lessened, but the tension seemed diminished; and the limb retained its natural temperature. On the 16th, the pulse was only eighty, and the tumour and throbbing of it had manifestly diminished. Venesection was afterwards practised several times, and about six ounces of blood came away from the wound. The patient died on the 20th, and was supposed to have been too much lowered by the rigorous antiphlogistic treatment. The origin of several large arterial branches from the subclavian near the tumour, is regarded as a great cause of the little success which this method of operating promises, as applied to subclavian aneurisms; yet, it deserves notice, that in the case before us, the vertebral, internal mammary, and inferior thyroid branches were all found obliterated. This, according to Dupuytren, must frequently happen, when the anuerism has attained a certain size; and, therefore, he infers, that their presence should not deter a surgeon from applying a ligature between the tumour and the capillaries. No doubt, the diseased state of the right lung, and the morbid changes observed in the aorta, as observed after death, must have had a very unfavourable influence. (*Clin. Chir.* t. iv. p. 594.) Dupuytren publicly declared, that the preceding case would not deter him from repeating a similar operation in the same kind of case. (P. 611.)

Ligature of the Arteria Innominata.

In certain cases of subclavian aneurism, it has been proposed to tie the arteria innominata. In the dead subject, Mr. Allan Burns applied two ligatures to it; and after cutting through the vessel in the interspace, he injected the aorta, when the injection was found to pervade the anastomosing vessels of the right arm, and all those of the head. But notwithstanding this fact, and others noticed by Mr. Hodgson, tending to show the probability, that a ligature upon the arteria innominata would not prevent the arm and head from receiving an adequate supply of blood, other objections were made to the practice. The principal of these were founded upon the difficulty of the operation in the living body; the inflammation likely to be excited by it in neighbouring important organs; the danger of hemorrhage from the adhesion of the vessel being likely to be broken by the force of the circulation; and the equal practicableness, in most cases, of tying the subclavian artery on the tracheal side of the scalenus.

Dr. Mott, of New York, impressed with the value of Mr. Allan Burns' remarks upon this subject, has, ever since he became acquainted with them, maintained in his lectures the propriety of attempting to tie the arteria innominata, under particular circumstances of subclavian aneurism. At length, Dr. Mott put this new operation to the test of experience in the New York Hospital, on the 11th of June, 1818. The case was a subclavian aneurism on the right side; and the patient, a sailor, aged fifty-seven, to whom seventy drops of tinct. opii were first given. Dr. Mott began the first incision directly over the swelling above the clavicle, extending it along this bone, and ended it at the trachea, just above the upper portion of the sternum. Here he commenced the second incision of about the same length as the first, and reaching along the inner margin of the sterno-cleido-mastoideus. Dr. Mott next detached the skin from the subjacent platysma myoides, cut through the latter, and cautiously divided the sternal portion of the mastoid muscle, in the direction of the first incision. The internal jugular vein now presented itself close to the swelling, and adherent to it; a circumstance that rendered the subsequent part of the operation very difficult. After detaching a portion of the latter vein from its connection, Dr. Mott cut through the sterno-hyoideus and sterno-thyroideus, and turned them back over the trachea. The carotid was now exposed a few lines above the sternum; and after he had separated the par vagum and internal jugular vein from it, they were drawn towards the outer side of the neck. Dr. Mott then laid bare the subclavian artery, which part of the operation he chiefly accomplished with the handle of the scalpel, as there was nothing to be separated but cellular membrane. The subclavian artery was found to be very much enlarged and diseased; and, as Dr. Mott recollected that this state of the vessel had seemingly hindered its successful closure, in the example operated upon by Dr. Colles, of Dublin, he decided to take up the arteria innominata itself. In detaching the cellular membrane from the lower surface of the subclavian artery, a small branch, situated about half an inch from the innominata, was injured, and the wound was six or eight times filled with blood from it. The hemorrhage was soon suppressed, however, by means of a little pressure. Had not the bleeding been so easily stopped, Dr. Mott would have concluded, from the situation of the vessel, that it was the internal mammary; but, if it were not this branch, he conceives it must have been an artery not regularly originating in this situation; perhaps the superior intercostal.

Dr. Mott continued the operation with a small round-ended sharp scalpel, until he came to the division of the arteria innominata, which great vessel he traced below the sternum; and after freeing it from all the cellular membrane with the handle of the scalpel, and drawing aside the recurrent and phrenic nerves, he tied it with a round silk ligature, about half an inch from its bifurcation.

On account of the difficulty of tying large arteries in a deep small wound, Dr. Mott recommends a set of instruments, invented for the purpose, in Philadelphia, by Drs. Parish, Hartshorn, and Hewson; consisting, 1st, Of several blunt-pointed needles, of various sizes and curvatures, furnished with an eye at each end, and calculated at one end to screw into a strong handle. 2dly, Two strong instruments, with handles, having at one end an eye, or hole; they resemble those sometimes used for applying a ligature to the tonsils. 3dly, A small round-pointed scalpel. 4thly, A small hook fixed in a strong handle. (*Parish, in Eclectic Rep.* vol. iii. p. 229.) After Dr. Mott had introduced the ligature into the eye of one of the above-described needles, and screwed the needle into a handle, he pressed with its convexity the cellular membrane and pleura carefully downwards, while he carried it from below upwards round the artery. As the point now appeared on the other side of the vessel, the above-mentioned hook was passed into its eye, and the handle unscrewed from the other end of it, when it was easily drawn out from under the artery, and the ligature left under the vessel. In this part of the operation, Dr. Mott urges the necessity of being particularly attentive to two important circumstances; one is, to convey the ligature round the artery from below upwards, as the only way to prevent injury of the pleura; and the other is, to fix the hook in the eye of the needle, before the handle is unscrewed from its other end, because, after this has been done, the needle loses all steadiness, and it is then difficult to get the hook into the eye.

With respect to the foregoing instruments, I may observe, that they are superseded by the needle constructed by Weiss.

Dr. Mott now made a noose, pressed it with the forefinger down to the artery, and tightened it very gradually, in order not to stop the flow of blood through the vessel all at once. A moderate constriction was kept up some seconds, so that the effect of the ligature upon the heart and lungs might be observed; and as no disturbance was produced in the functions of these organs, Dr. Mott tightened the ligature, and stopped the current of blood through the vessel. At this instant, the pulsation of the right temporal and radial arteries ceased. The noose was tightened still more with the above-mentioned ligature irons, and then a second knot was made. Dr. Mott was greatly pleased at finding his patient's countenance remain perfectly unchanged, and no complaint made of pain in any other part. Immediately after the ligature had been applied, the aneurismal swelling lost one third of its size, and the clavicle could be felt through its whole extent. The divided muscles and detached skin were now brought into their natural situation; the wound closed with three sutures and adhesive plaster, and a compress applied. In the operation, three small arteries were tied: the first lay under the sternum, and seemed to be a branch of the internal mammary; the second was a descending branch of the superior thyroideal; and the third a branch of the inferior thyroideal. From two to four ounces of blood were lost, most of which came from an injured small branch of the subclavian. The operation took up about an hour. The curved spatulæ, recommended by Dr. Colles, were found very useful for holding the carotid and par vagum aside, while, by their uniform pressure, they materially assisted in restraining the effusion of blood from small vessels, and, as taking up little room, were infinitely more convenient in a deep narrow wound, than the fingers of an assistant.

The day after the operation, the veins of the right forearm and hand had a turgid appearance. When the circulation in them was promoted by pressure, they became empty for some distance above the pressed part, but filled again immediately the pressure was removed; a circumstance that seemed to show, that the circulation in this arm, notwithstanding the ligature of the arteria innominata, still went on with great celerity, though no pulse could be felt in the brachial and radial arteries. On the contrary, the pulse was very plain in the front branch of the temporal artery, just above the outer angle of the orbit. The left external carotid beat with unusual force. In a few days, however, the pulse became perceptible again at the right wrist.

My limits will not allow me to enter into all the details of this interesting case: suffice it to mention that the patient suffered considerable febrile disturbance at some periods after the operation, and it was necessary twice to have recourse to venesection. He was also afflicted with a severe cough. The discharge from the wound was copious and fetid. The main ligature separated on the fourteenth day. On the twentieth day, the patient was sufficiently recovered to walk in the garden. On the twenty-first day, the wound was almost closed; the patient could move his right arm with the same facility as his left, and he was gaining such strength, that no doubts were entertained about the successful result of the operation. On the twenty-third day, hemorrhage came on from the wound; it was stopped by the introduction of lint, and the employment of pressure. About twenty-four ounces of blood were lost, whereby the patient was so depressed, that the pulse was no longer distinguishable. On the twenty-fourth day, in the evening, he lost four ounces more blood; on account of his restlessness and the painful state of his arm, two grains of opium were administered to him. After one or more returns of bleeding, he died on the twenty-sixth day.

When the body was opened, no traces of inflammation or its consequences were found either in the arch of the aorta, the origin of the innominata, of the lungs. The aorta was now slit open longitudinally, and a probe then cautiously passed through it into the innominata, when the instrument went through the latter vessel into the cavity of the wound. The inner coat of the innominata was smooth and soft; but, about half an inch from the place where the ligature had cut through the vessel, marks of inflammation were noticed, and a coagulum adhered to the sides of the artery with considerable firmness; so that nature had probably endeavoured, by means of adhesive inflammation, to close the vessel, but had been prevented from completing the salutary process by the destructive ulceration. One portion of the parietes of the innominata was thickened by inflammation, and an anomalous branch, as large as a crow's quill, arose from this artery.

The ulcer was twice as extensive inwardly as it was superficially, reaching laterally to the trachea and under the clavicle to the swelling. The tripod of great vessels, viz. the innominata, the subclavian, and the carotid, was destroyed by ulceration to the extent of about an inch, and the ends of both the last vessels opened into the wound. At this place, the pleura was considerably thickened by a layer of organized lymph.

The inner surface of the carotid was covered with a coagulum, and its coats so much thickened, that a probe could hardly be passed into it. The consolidation reached up to the division into the external and internal carotid. The subclavian was pervious as far as the situation of the disease. The diameter of the brachial and other arteries of the right arm was natural. The external mammary artery was enlarged, but not the internal. The clavicle was carious, and several lymphatic glands under it in a state of suppuration.

Though the result of the operation was unsuccessful, it proves, as Dr. Mott correctly remarks, some interesting points; namely, that tying an artery of such magnitude, and so near the heart, may be done without occasioning any disturbance either in the functions of the brain, the heart, the lungs, or the right arm.

The suppuration, which continually extended itself more and more deeply, is set down by Dr. Mott as the cause of the patient's death; for, as no bleeding took place for several days after the detachment of the principal ligature, he believes that this must have fulfilled its duty, and that the artery had been closed. (See *New York Med. and Surgical Register*, 1818, vol. i.)

The arteria innominata was also tied by Graefe on the 5th of March, 1822, in the Clinical Hospital of the University of Berlin, on account of a subclavian aneurism. The carotid was exposed, and traced down to the innominata, to which a ligature was applied by means of a blunt tenaculum constructed for the purpose, the vessel being tied about an inch from the curvature of the aorta, and two inches from the heart. As soon as the ligature was tightened, the pulsation of the arteries of the right arm, right carotid, and right temporal artery, ceased; at the same instant, the throbbing of the aneurism stopped, and the tumour became flaccid. The constriction of the cord produced no disturbance of any function. The patient went on so well for several weeks afterwards, that no doubt was entertained of his recovery. However, when the wound was nearly healed, hemorrhage came on; and though it was suppressed, and hopes began to be again indulged, the bleeding recurred, and the patient died on the sixty-seventh day. Below the ligature the innominata was found closed with lymph. Graefe has written a distinct essay on the method in which the operation was done: the daily particulars of the case, and preparation from it, are placed in the Royal Anatomical Museum at Berlin. (See *Journ. de Chirurgie von C. F. Gräfe, und Ph. v. Walther*, b. iii. p. 596, &c., b. iv. p. 587.) The ligature of the innominata is stated to have been lately done at Paris; but in this third example the patient also died of hemorrhage. (See *Dupuytren, Leçons Orales, &c.* t. iv. p. 611.) Of Mr. Wardrop's practice of tying the subclavian artery in aneurism of the arteria innominata itself, we shall presently speak.

CAROTID ANEURISMS.

There is no part of the body where the diagnosis of aneurisms is more liable to mistake than in the neck. Here the disease is particularly apt to be confounded with tumours of another nature. I have already cited, in this article, examples in which aneurisms of the arch of the aorta so resembled those of the carotid, as to have deceived the surgeon who was consulted. A swelling of the lymphatic glands, or of the cellular substance which surrounds the carotid artery; an enlargement of the thyroid gland; and especially abscesses, may resemble an aneurism by the pulsations communicated to them from the neighbouring artery. On the other hand, aneurisms of long standing, which no longer throb, and the integuments over which are changed in colour, and likely to burst, may the more easily be mistaken by an inattentive practitioner for chronic abscesses, as the neck is remarkably often the seat of such diseases. (*Boyer, Maladies Chir.* t. ii. p. 185.)

Scarpa mentions one unfortunate patient, who was killed by a knife being plunged in a carotid aneurism, on the supposition that the case was an abscess. I need scarcely observe, that by opening a carotid aneurism, a surgeon would expose himself to the disgrace and mortification of seeing the patient die under his hands, as happened in the example cited by Harderus. (*Apiar. Observationum*, Obs. lxxxvi.)

The possibility of tying the carotid artery, in cases of wounds and aneurisms, without any injurious effect on the functions of the brain, is now completely proved. Petit mentions, that the advocate Vicillard had an aneurism at the bifurcation of the right carotid, for the cure of which he was ordered a very spare diet, and directed to avoid all violent exercise. Three months afterwards, the tumour had evidently diminished; and, at last, it was converted into a small, hard, oblong knot, without any pulsation. The patient having died of apoplexy, seven years afterwards, the right carotid was found closed up and obliterated, from its bifurcation, as low down as the right subclavian artery. (*Acad. des Sciences de Paris*, an. 1765.) Haller dissected a woman, whose left carotid was impervious. (*Opuscula Pathol. Obs.* xix. tab. 1.) An example of the total closure of both carotids, in consequence of ossification, is stated by Koberwein to be recorded by Jadelot. (*German Transl. of Mr. Hodgson's Work*, p. 293.) Hebenstreit (vol. iv. p. 266. ed. 3. of his *Translation of B. Bell's Surgery*) mentions a case, in which the carotid artery was wounded, in the extirpation of a scirrhous tumour. The hemorrhage would have been fatal, had not the surgeon immediately tied the trunk of the vessel. The patient lived many years afterwards. This is probably the earliest authentic instance, in which a ligature was applied to the carotid artery. Mr. Abernethy's case is perhaps the second; and that in which Mr.

Fleming, a naval surgeon, tied the common carotid in a sailor, who attempted suicide, and who was saved by the operation, is still later, not having occurred till the year 1803. (See *Med. Chir. Journ.* vol. iii. p. 2.)

Dr. Baillie knew an instance, in which one carotid was entirely obstructed, and the diameter of the other considerably lessened, without any apparent ill effects on the brain. (See *Trans. for the Improvement of Med. and Chir. Knowledge,* vol. i. p. 121.) Sir Astley Cooper has also recorded an example, in which the left carotid was obstructed by the pressure of an aneurism of the aorta; and yet, during life, no paralysis, nor impairment of the intellects, had occurred. (See *Med. Chir. Trans.* vol. i. p. 223.) A similar case is related by Pelletan. (*Clin. Chir.* t. i. p. 68.)

Mr. Abernethy was under the necessity of tying the trunk of the carotid, in a case of extensive lacerated wound of the neck, where the internal carotid, and the chief branches of the external carotid were wounded. The patient at first went on well; but, in the night, he became delirious and convulsed, and died abuot thirty hours after the ligature was applied. This case fell under my own notice; and the inference which I drew was, that the man died more from the great quantity of blood which he lost, and the severe mischief done to the parts in the neck, than from any effect of the ligature of the artery on the brain.

In another instance, in which the common carotid was tied, on account of a wound of the external carotid, by a musket-ball, complicated with fracture of the condyle and coracoid process of the lower jaw, every thing went on favourably until the seventh day after the operation. Neither the intellectual faculties, nor the functions of the organs of sense, had been at all disturbed. But, at that period, stupor, confusion of ideas, restlessness, a small unsteady pulse, discoloration of the face, and loss of strength came on, followed in the evening by a violent paroxysm of fever. On the eighth day, three copious hemorrhages took place from the whole surface of the wound; and, on the ninth, the man died. In this case, however, the affection of the brain, and the other unfavourable symptoms, would be ascribed by nobody to the effects of the ligature on the carotid, but every one would see the cause in the severe and extensive local mischief, produced partly by the musket-ball, and partly by the mode in which the operation was performed, the surgeon having extended his incisions from the parotid gland to within an inch of the clavicle! (See *Journ. Général de Méd. &c. par Sedillot.*)

That the carotid may be tied without injuring the functions of the brain, and that aneurisms of this artery admit of being cured by the operation, is now fully proved. The following is the second instance, in which I have been present at the operation of tying the carotid trunk on account of a wound.

A soldier of the 44th regiment was wounded in the neck, with a pike, at the battle of Waterloo, and was brought to Brussels. After he had been some little time in the hospital, the bleeding, which had stopped, recurred with great violence, both from the mouth and the external wound itself; and it was therefore judged necessary to tie the common carotid, which was done by my friend Mr. Collier. The operation was performed by making an incision through the skin, superficial fascia, and platisma myoides, along the inner edge of the sterno-cleido-mastoideus, raising this muscle from the sheath including the artery, &c., and holding aside the jugular and lower thyroid veins, which swelled up every instant to a very large size, so as to overlap the artery. The deep cervical fascia and carotid sheath were then carefully opened; and the artery having been exposed, a ligature was passed under from without inwards, so as to avoid injuring the vein, or including the nervus vagus in the ligature. Though the operation was done by candlelight, it was skilfully performed, and reflects great credit on Mr. Collier. A detail of the case may be found in a modern work. (*Med. Chir. Trans.* vol. vii. p. 107.)

Another example, in which the carotid artery was tied, and the patient saved, in a case where it was wounded with a penknife, was published by Dr. John Brown, surgeon to the County of Meath Infirmary. (See *Dublin Hospital Reports*, vol. i. p. 301. &c.) In this instance, the internal jugular vein "did not appear, nor was it a source of the slightest inconvenience during the operation." (P. 305.) A case, very analogous to the foregoing, is recorded by Mr. Hodgson, and the event equally successful. "The jugular vein afforded no trouble in the operation: it was not even seen." A gradual improvement of the power of deglutition marked the gradual subsidence of the tumour, which pressed against the pharynx. Nor was any change perceived in the state of the patient's mind after this operation, who remained as she had been previously, melancholy and dejected. (P. 332.)

Acrel mentions an example, in which the carotid artery was wounded by a gunshot, and the hemorrhage permanently stopped by compression. A similar case is related by Van Horne, in his annotations to the work of Botallus. (*De Vuln. Sclopetis.*) Baron Larrey has likewise related a case, in which the carotid was wounded by a musket-ball, and life saved by the instant appplication of pressure. (*Mém. de Chir. Mil.* t. i. p. 309.) However, considering the size of the vessel, and its unfavourable situation for being effectually and steadily compressed, some doubts may be entertained, whether the vessel wounded might not rather have been one of its branches.

Sir Astley Cooper has the honour of having been the first surgeon who ever tied the carotid for the cure of aneurism. The operation, referred to, was performed Nov. 1805, on Mary Edwards, aged forty-four, who had an aneurism of the right carotid artery: the tumour reached from the vicinity of the chin to beyond the angle of the jaw, and downward to within two inches and a half from the clavicle. The swelling had a strong pulsatory motion. The woman also complained of a particular tenderness of the scalp, on the same side of the head, and of such a throbbing in the brain as prevented her from sleeping.

An incision, two inches long, was made at the inner edge of the sterno-cleido-mastoideus muscle, from the lower part of the tumour to the clavicle. This wound exposed the omo-hyoideus and sterno-hyoideus muscles, which being drawn aside towards the trachea, the jugular vein presented itself to view. The motion of this vein produced the only difficulty in the operation, as, under the different states of breathing, the vessel sometimes became tense and distended under the knife, and then suddenly collapsed. Sir Astley Cooper introduced his finger into the wound, to keep the vein out of the way of the knife; and, having exposed the carotid artery by another cut, he passed two ligatures under this vessel by means of a curved aneurism-needle. Care was taken to exclude the recurrent nerve on the one hand, and the par vagum on the other. The ligatures were then tied about half an inch asunder; but the intervening portion of the artery was left undivided. The pulsation of the swelling ceased immediately the vessel was tied; and, on the day after the operation, the throbbing in the brain had subsided, while no diminution of nervous energy in any part of the body could be observed.

The patient was occasionally afflicted with bad fits of coughing, but, upon the whole, went on at first pretty well. On the eighth day, however, a paralysis of the left leg and arm was noticed, attended with a great deal of constitutional irritation. November 8th, the patient could move her arm rather better; but became unable to swallow solids. November 12th, the palsy of her arm had now almost disappeared. The ligatures came away. November 14th, she was in every respect better; she swallowed with less difficulty; and the tumour was smaller, and quite free from pain. On the 17th, she became very ill; the tumour increased in size, and was sore when pressed. The wound was as large as immediately after the operation, and discharged a sanious serum. Great difficulty of swallowing, and a most distressing cough, were also experienced. The pulse was ninety-six, and the left arm again very weak. On the 21st, the patient died, the difficulty of swallowing having previously become still greater, attended with a further increase of the tumour, the skin over which had acquired a brownish red colour.

On opening the swelling after death, the aneurismal sac was found inflamed, and the clot of blood in it was surrounded with a considerable quantity of pus. The inflammation extended on the outside of the sac, along the par vagum, nearly to the basis of the skull. The glottis was almost closed, the lining of the trachea was inflamed and covered with coagulating lymph. The pharynx was so compressed by the tumour, which had been suddenly enlarged by the inflammation, that a bougie of the size of a goose-quill could hardly be introduced into the œsophagus. Sir Astley Cooper concludes with expressing his opinion that *these causes of failure may, in future, be avoided by operating before the tumour is of such size as to make pressure on important parts; or, if the swelling should be large, by opening it, and letting out its contents, as soon as inflammation comes on.* (See *Med. Chir. Trans.* vol. i.)

In one case, under the care of Mr. Coates, of Salisbury, the making of an opening, about a month after the operation, gave relief by discharging seven ounces of fetid blood and pus; but, three weeks afterwards, hemorrhage came on from the sac, and the patient was carried off by repeated loss of blood. On dissection, an artery, capable of admitting a probe, was found to pass into the cavity of the sac. (See *Med. Chir. Trans.* vol. xi. p. 2.)

In June, 1808, Sir Astley Cooper operated, in Guy's Hospital, on a man, aged 50, who had a carotid aneurism, attended with pain on one side of the head, throbbing in the brain, hoarseness, cough, slight difficulty of breathing, nausea, giddiness, &c. The patient got quite well, and resumed his occupation as a porter. There was afterwards no perceptible pulsation in the facial and temporal arteries of the aneurismal side of the face. On the opposite side, the temporal artery became unusually large. The tumour was at last quite absorbed, though a pulsation existed in it till the beginning of September. The man's intellects remained perfect; his nervous system was unaffected; and the severe pain, which, before the operation, used to affect the aneurismal side of the head, never returned. The swelling, at the time of the operation, was about as large as a pullet's egg, and situated on the left side about the acute angle made by the bifurcation of the common carotid, just under the angle of the jaw.

Sir Astley Cooper began the incision opposite the middle of the thyroid cartilage, at the base of the tumour, and extended the wound to within an inch of the clavicle, on the inner side of the sterno-cleido-mastoideus muscle. On raising the margin of this muscle, the omo-hyoideus could be distinctly seen crossing the sheath of the vessels, and the nervus descendens noni was also brought into view. The sterno-cleido-mastoideus was now separated from the omo-hyoideus, when the jugular vein was seen. This vessel became so distended at every expiration as to cover the artery. When the vein was drawn to one side, the par vagum was manifest, lying between that vessel and the carotid artery, but a little to the outer side of the artery. The nerve was easily avoided. A double ligature was then conveyed under the artery with a blunt iron probe. The lower ligature was immediately tied, and the upper one was also drawn tight, as soon as about an inch of the artery had been separated from the surrounding parts above the first ligature, so as to allow the second to be tied at this height. A needle and thread were passed through the vessel below one ligature, and above the other. The artery was then divided. In a little more than nine weeks, the wound was quite healed, and the patient entirely recovered. (See *Med. Chir. Trans.* vol. i.)

Another successful instance, in which the carotid was tied for the cure of an aneurism, is related in a work, to which I always have the greatest pleasure in referring. (See *Hodgson's Treatise on the Diseases of Arteries,* p. 329.)

Mr. Travers tied the carotid artery in a woman, who had an aneurism by anastomosis in the left orbit. The disease had pushed the eye out of its socket. Two small ligatures were applied, which came away on the twenty-first and twenty-second days. No hemorrhage, nor impairment of the function of the brain, took place, and the disease in the orbit was effectually cured. (See *Med. Chir. Trans.* vol. ii.) Another highly interesting example, in which an aneurism by anastomosis in the orbit was effectually cured by tying the carotid artery, is recorded by Mr. Dalrymple, surgeon at Norwich. This gentleman performed the operation on the 12th of November, 1812. The patient was a female, aged 44. The protrusion of the eye was relieved in proportion as the swelling diminished. The violent headaches also subsided; but the eyesight was irrecoverably lost. (See *Med. Chir. Trans.* vol. vi. p. 111.)

The carotid artery has sometimes been tied, with the view of enabling the surgeon to cut away swellings from the neck and side of the face, where, from particular circumstances in the cases, there was reason to fear a fatal hemorrhage without that preliminary measure. (See *Goodlad's and Arenat's Cases, in Med. and Chir. Trans.* vols. vii. and xii.)

An interesting case, in which my friend Mr. Vincent tied the carotid trunk for an aneurism, is published in the 10th vol. of the latter work. (P. 212, &c.) In this example, the internal jugular vein did not appear to be at all in the way during the operation; some of the fibres of the omohyoideus, however, could not be conveniently drawn aside, and were therefore divided. A single ligature was applied; the pulsation in the tumour did not entirely cease, at first, when the artery was tied, but it did so two days afterwards; and the swelling was rapidly diminishing. The ligature came away about three weeks after the operation, and there was every hope of a cure; but, between the fourth and fifth week, a considerable swelling occurred between the wound and the jaw, impeding deglutition, but not the breathing. This state was followed by febrile symptoms, increased difficulty of swallowing, an attack of coughing, and impeded respiration. In the hope of affording relief, an incision was made in the tumour, from which a small quantity of pus and coagulum issued; but it was in vain, for the patient was dying. On dissection the carotid artery was found perfectly closed as far as the division of the arteria innominata. But, above the ligature, the vessel was open and inflamed, and pus was found in it. The most remarkable circumstance noticed was globules of air, adhering to the inner surface of the aorta, and other large arteries, and found also under the tunica arachnoidea. The bulk of the swelling in the neck depended upon effusion of serum in the cellular membrane.

The cure of carotid aneurisms by the operation has now been so often exemplified, that even to refer to every case upon record would demand more space than I can afford. A successful instance is reported by Macaulay (*Edin. Med. Surg. Journ.* April, 1814); another by Dr. Post, who used two ligatures, and divided the artery in the space between them (*New England Journ. of Medicine and Surgery*, vol. iii. p. 205. Boston, 1814); another by Mr. Giles Lyford, proving the sufficiency of a single ligature (*Med. Chir. Trans.* vol. xi. p. 97, &c.) The case in which Mr. Goodlad tied the carotid, in order to prevent hemorrhage in the removal of a tumour involving the parotid gland, is contained in vol. vii. p. 112, &c. of the latter book. The example, in which the carotid was tied by Dr. Frick, in the hospital at Hamburgh, for the cure of a diseased parotid, is reported in the *Lancet*, No. 182. Some diminution of the swelling, and increased power of swallowing, followed; but suppuration took place, and the case ended fatally.

For the particulars of a carotid aneurism cured by the ligature of the artery by M. Dumont, see *Diss. sur l'Aneurisme de l'Artère Carotide, par P. J. Vanderhagen*, Paris, 1815. Walther, of Landshut, in the year 1814, tied the carotid artery for the cure of an aneurism with complete success: he applied only a single ligature. (*Breschet, Fr. Transl. of Mr. Hodgson's Work*, t. ii. p. 83.) In this translation are reported several instances, in which Dupuytren and other Continental surgeons applied a ligature to the carotid. Dr. Holscher, of Hanover, has also operated with success. (See *Lond. Med. Repository*, vol. xvi. No. 94.)

Of the plan of tying the carotid above the aneurism, when it is situated so low that the ligature cannot be applied below it, I have also spoken. The facts, by which the propriety of this practice has now been completely established, have also been noticed: they appear to me to reflect considerable credit on Mr. Wardrop, by whom this method of operating has been revived and extended. The practice of tying the carotid for the cure of aneurism of the arteria innominata will be noticed in the ensuing section.

On the subject of tying both carotids, I find some interesting observations made by my friend Mr. Crosse: — "Although (says he) some animals will bear a ligature to both carotids simultaneously, the human frame cannot sustain so great and so sudden an interruption to the supply of blood to the sensorium. Professor Mott has tested this question; and a case came under my own observation very recently, showing the fatal tendency of a ligature, if applied almost simultaneously to each of these arteries. An approximation has, however, been made towards ascertaining the shortest interval, at which the second carotid may be tied after a ligature to the first; and it has been safely done at an interval of thirty-eight, seventeen, and even twelve days. Amongst the most striking of these cases, is that related by Professor Kuhl of Leipzig, who, on account of a pulsating aneurismal tumour of the scalp, arising from a wound of the occiput, and extending over nearly the entire surface of the head, attended by frequent hemorrhages, first placed a ligature on the left common carotid. This proceeding only partially subduing the disease, and frequent hemorrhages from the affected portion of the scalp still occurring, and threatening life, a ligature was put upon the right common carotid after twenty-seven days. This was followed by convulsions; but, after a train of very troublesome symptoms, the patient recovered, and was cured of his disease. It is worthy to be noticed, that in this, and also in other like cases, some days after both carotids had been tied, heaviness and throbbing in the head have occurred, requiring free venesection. (*J. Green Crosse, in Provincial Med. Chir. Trans.* vol. v.)

For anatomical engravings of the parts, concerned in the operation of taking up the carotid artery, see those of Tiedemann (*Tabulæ Arteriarum*), of Rosenmüller (*Chirurg. Anatom. Abbildungen*, th. i. tab. 7, 8, 9.), and Elias Bujalsky, (*Tab. Anat. Chir. Petropol.* 1828, tab. 1, 2, et 3.) Also J. P. Manec (*Sur la Lig. des Artères*, fol. Paris, 1832).

New Operation for Aneurism of the Arteria Innominata.

It having been established, that aneurisms may be cured by simply lessening the impetus of the blood flowing through them, and that, although a circulation may yet continue in them for some time, the layers of coagulable lymph within the sac augment, and ultimately bring about a complete consolidation of the swelling, it occurred to Mr. Wardrop, that in aneurism of the arteria innominata, the progress of the disease might be arrested by tying its two great branches, the carotid and subclavian. Although a certain portion of blood would still continue to pass along the innominata to those branches of the subclavian on the cardiac side of the ligature, the ligature being necessarily placed on the subclavian artery, after it emerges from between the scaleni muscles, Mr. Wardrop conceived that such would yet be the diminution of the impetus of the blood in the sac, that the future increase of the tumour would be prevented, and even a permanent obliteration of the aneurismal cavity would be accomplished. (*On Aneurism*, p. 58.) The knowledge of this principle, indeed, he thinks, may be useful in the cure of many aneurisms, which have hitherto been considered beyond the reach of art. In an aneurism of the innominata, Mr. Mackelcan found that nature had nearly completed a cure on this principle. The carotid artery was plugged up, and the large aneurismal swelling was filled with a coagulum, leaving only a comparatively small channel for the passage of the blood into the subclavian artery. (See *Appendix to Wardrop on Aneurism.*) However, Mr. Guthrie takes a different view of this case, and infers that a ligature on the carotid above the aneurism would have been of no use, so far as the obliteration of the arteries was concerned, unless it had been followed by inflammation of the sac and coagulation of its contents. (See *Guthrie on the Dis. of Arteries*, p. 206.) He makes this inference, because though the artery was rendered impervious, by a natural process, the disease went on increasing, till it destroyed the patient. The coagulation of blood is all that the advocates of this plan have in view. Mr. Wardrop has seen instances, and several are on record, which illustrate the important pathological fact, and prove, beyond a doubt, that blood may coagulate in an aneurism so as to strengthen the parietes of the sac, and ultimately fill its cavity, without the circulation in the sac being in the first instance either suddenly or entirely interrupted.

It was the knowledge of this fact, that led Mr. Wardrop to perform the operation which he has related. Nature, in the case alluded to, had already instituted a curative process by diminishing the circulation in the carotid artery; and, when he found this alone not sufficient to stop the enlargement of the aneurism, he determined to place a ligature on the subclavian. In doing this, he conceived that he was strictly imitating the process which nature herself had commenced. (P. 61.) The case of Mrs. Denmark, aged 45, in whom he tied the subclavian artery, and thus cured an aneurism of the arteria innominata, is highly interesting. The particulars may be read in his own publication, or in the *Lancet* for 1827. Suffice it here to state, that the operation had the effect of diminishing the size of the tumour, and causing it almost to disappear. The swelling afterwards enlarged, however, and the patient died. In the *post mortem* examination, the tumour was found occupying the central space between the sterno-mastoid muscles, and composed of three portions; one arising immediately above the sternum; another upwards along the trachea; and the third was the original portion of the aneurism, consolidated by the effects of the operation. The swelling, which underwent no diminution after death, felt like a firm fleshy mass. On laying it open longitudinally, it appeared nearly solid. The clavicular and tracheal portions of the sac were filled with firm coagulum, the cavity being chiefly limited to the division between the sternal and tracheal portions, and it was about the size of a walnut. The coats of the aorta were somewhat thickened; and it presented a few points of ossification. "On cutting into the innominata from the aorta, the aneurism was found to have originally extended from its origin to its bifurcation. The subclavian artery is divided at the place where the ligature had been applied; and both the cardiac and distal orifices are contracted, and the sides of the vessel coalesce, and adhere firmly together. The right carotid pervious, and quite healthy." I think with Mr. Guthrie, that the account of the dissection would have been improved by the statement, whether the branches of the subclavian, giving off nearer the heart than the ligature, were pervious, or not. The following is the view taken by Mr. Guthrie of Mrs. Denmark's case: "It appears to me (he observes) that the operation gave rise to inflammation, and consequent coagulation in the sac, which led to a diminution of its size, without interfering with the channel by which the blood passed into the right carotid. The disease was therefore, for the time, arrested; but, as the artery was unhealthy in the parts surrounding the aneurism, it again returned, and ultimately destroyed the patient. The same thing is clearly taking place in Mr. Evans's patient." (See *Guthrie on the Dis. of the Arteries*, p. 190.) In the advertisement prefixed to this work is a similar prognostication with reference to Dr. Mott's very interesting case. In the appendix to Mr. Wardrop's publication, and in the *Lancet* for November, 1828, is a case in which Mr. Evans, of Belper, Derbyshire, treated an aneurism of the innominata and root of the carotid, by tying the latter vessel. Three months after the operation, the patient, a butcher and horse-dealer, thirty years of age, was well enough to attend regularly the markets and fairs of Derby, seven miles from his home. In the course of the case, three remarkable circumstances occurred: 1st, An obliteration of the principal arteries of the right arm. 2dly, A profuse salivation. 3dly, A disposition to paralysis of the right side; supposed, by Mr. Evans, to have arisen from a greater quantity of blood being sent to the left hemisphere of the brain than to the right. However, as such paralysis has not attended other operations, in which the carotid was tied, the truth of the explanation seems doubtful. The palsy afterwards nearly subsided. This case did not terminate, however, in a cure; for he led a very irregular life, and the tumour, which had been stationary, began to increase, and another tumour made its appearance on the other side of the sternum. "If I were to hazard an opinion (says Mr. Evans), I should be disposed to affirm, that the operation succeeded in arresting the disease for a time, and that, under more favourable circumstances, that time might have been prolonged: but, the patient's return to his usual irregular habits, and the fatigue and exercise his avocations necessarily led him into, excited the disease in the lower portion of the innominata, or, perhaps, in the aorta itself; for the original tumour is yet easily distinguished from the later enlargements." Of course, until the time for a *post mortem* examination arrives, this case must be attended with obscurity. The following are some of the particulars of the case, in which Dr. Mott, of New York, tied the carotid artery for an aneurism of the innominata. The patient, Moses R. Gardner, aged 51, a farmer, of sound constitution, and good habits of life, about three years before he consulted this gentleman, while occupied in removing a building, was attacked with pain in the upper and back part of the neck. This afterwards extended to the right shoulder and arm, but, in time, partially subsided, and his voice became hoarse. About eighteen months before he consulted Mr. Mott, he discovered a small swelling at the upper part of the breast-bone, but did not at first remark any throbbing in it. Dr. Mott found, above the sternum, a pulsating tumour, about the size of a pigeon's egg, spreading some distance under the clavicular and sternal portions of the right sterno-mastoideus, in the course of the subclavian artery, and extending as low down as the second rib, compressing the bronchial tubes, and producing, on the least coughing or exercise, a wheezing, not unlike that of asthma. The patient shrunk from the least pressure upon it, complaining of impeded respiration, followed by pain; its pulsations were synchronous with those of the heart, and decidedly aneurismal.

After fully explaining to him the nature of his disease, and its probable fatal termination should it be left to itself, Dr. Mott advised him to return to his home, to avoid all exertion, to be occasionally bled, and to confine himself principally to a vegetable diet; but, should he observe the least increase, either in the tumour or any of his symptoms, to apply again. In a few months, he again came to New York. Dr. Mott now found that the tumour above the sternum had much increased, and, upon a careful application of the stethoscope, that it had evidently encroached more upon the chest. The *bruit de soufflet* could be heard; the thoracic viscera were sound, and the respiratory murmur distinct. In either speaking, walking, or coughing, respiration was very much impeded, and almost entirely suspended by the least pressure upon the tumour. The action of the right carotid was more feeble than that of the left, and no pulsation could be felt in its branches; the right subclavian, external to the scaleni muscles, was natural, while the axillary and brachial arteries could hardly be felt; and at the wrist no pulse could be distinguished; but the pulsations of the arteries of the left side were natural. The general health was good.

Dr. Mott was persuaded the aneurism was one of the arteria innominata, involving the subclavian and the root of the carotid, and he considered it a proper case for the operation proposed and successfully performed by Mr. Wardrop. From the evident interruption of the circulation in the right arm, and the apparent efforts of nature to effect a spontaneous cure, he determined to tie the carotid first, and afterwards the subclavian, should it be required.

"On the 20th Sept. the artery was taken up in the usual manner. 27th, 9 A. M. Slept well, and feels refreshed; thinks there is more room, as he expresses it, in breathing; complains of a little soreness of the tonsils; pulse 58, regular and tranquil; the skin natural; pulsation and size of the tumour evidently diminished. 9 P. M. Much more restless; pulse 68, and tense; in other respects the same as in the morning; being habituated to laudanum, was permitted to take a teaspoonful. 28th, 9 A. M. Slept well; breathes more easily: feels less of the pulsation in the tumour; pulse 63, and not so tense; skin natural, and cough less. Ordered a dose of magnesia and Epsom salts. 9 P. M. Has passed a comfortable day. His wife, who arrived from the country since the morning, expressed her surprise at the improvement in his voice and breathing, as well as at the difference in the beating. Pulse of the right radial artery very distinct, but intermitting from ten to fifteen beats; in the left arm 80, and stronger; coughs frequently, and expectorates freely; skin natural; tongue a little white; salts have not operated. Ordered the dose to be repeated; and if restless after its operation, to take his usual anodyne. 29th. Saluted Dr. Mott this morning with a full and fine voice, and said he was well enough to call on him. His cough and expectoration much less. Dr. Mott found him lying down, and breathing quietly; pulse 71, and regular. The radial artery of the right arm beating as last evening, with fewer intermissions, but of longer continuance; skin over the tumour more wrinkled; pulsation less and weaker. The ligature came away on the night of the 15th, and the *tumour above the sternum, and pulsation, entirely had disappeared*; the cough and breathing better; voice nearly natural; pulse 66, with now and then a very faint pulsation of the right radial artery; right hand a little swelled, and numbed. 22d. Wound has just healed; weakness of the arm considerable; fingers very thick and clumsy; whole arm swelled, and pits upon pressure; no pulse in the right radial artery; breathing easy; cough and expectoration much less; can sleep easy in any position, *which he has not been able to do for many months*. 26th. Left town for his residence in New Jersy." Of course, the profession will be anxious to hear the further history of this case; and I entertain a hope that Mr. Guthrie's prognostication may not be verified.

Of Aneurisms of the Aorta, and Valsalva's Treatment.

This afflicting and fatal disease is by no means unfrequent, and the arch of the aorta is its most common situation. Dr. Hunter was of opinion, that the latter circumstance depended on the forcible manner, in which the blood, propelled from the left ventricle of the heart, must be driven against the angle of the curvature of the vessel. Mr. A. Burns considered aneurism of the thoracic aorta more frequent, perhaps, than that of any other vessel in the body. "I have had (says he) an opportunity of examining fourteen who had died of this disease, but have not seen more than three instances of external aneurism." (*On Diseases of the Heart, &c.* p. 215.) These proportions, however, would not correspond to common observation, external aneurisms, taken collectively, being supposed to be about as numerous as those of the aorta alone, a calculation long ago made by Dr. A. Monro, primus.

It was the opinion of Dr. W. Hunter, that the aneurismal sac was composed of the dilated coats of the artery, which parts nature thickened and studded with ossifications, after the origin of the disease, for the purpose of resisting its increase. Mr. Hodgson also declares his decided belief, and adduces facts to prove, that many aneurisms of the aorta are formed by dilatation. Yet the celebrated Scarpa believed, that the generality of aneurisms of the aorta were the consequence of a rupture of the proper coats of this large vessel; and that its cellular sheath was distended into the aneurismal sac. While Dr. W. Hunter considered the ossifications of the sac as consequences of the disease, Haller looked upon the scales of calcareous matter in the aorta as the very cause of the affection, by rendering the artery inelastic, and incapable of yielding to each pulsation of the heart. On this point, Haller was right.

Aneurisms of the aorta are most common in persons who are advanced in life; and the aorta of every old subject, whether affected with aneurism or not, is very commonly marked in some place or another with ossifications, or, rather, with calcareous concretions. Such productions occasion a decay, or absorption, of the muscular and inner coats of the vessel, so that at length the force of the blood makes the artery give way; and this fluid, collecting on the outside of the laceration, or rupture, gradually distends the external sheath of the artery into the aneurismal sac.

"If any person, who is not prejudiced in favour of the common doctrine, with regard to the nature and proximate cause of this disease (says Scarpa), will examine, not hastily and superficially, but with care and by dissection, the intimate structure and texture of the aneurism of the aorta, unfolding with particular attention the proper and common coats of this artery, and, in succession, those which constitute the aneurismal sac, in order to ascertain distinctly the texture and limits of both, he will clearly see, that the aorta, properly speaking, contributes nothing to the formation of the aneurismal sac, and that, consequently, the sac is merely the cellular membrane, which, in the sound state, covered the artery, or that soft cellular sheath, which the artery received in common with the neighbouring parts. This cellular substance being raised and compressed by the blood, effused from the corroded or lacerated artery, assumes the form of a circumscribed tumour, covered externally, in common with the artery, by a smooth membrane, such as the pleura in the thorax, and the peritoneum in the abdomen." Scarpa then comments upon the differences of the mere dilatation of an artery from aneurism, a subject which has been already fully considered in the foregoing pages. (*Scarpa on the Anatomy, Pathology, and Surgical Treatment of Aneurism, transl. by Wishart*, p. 55, 56.)

As I have already explained, in the preceding columns, the views taken of this part of the subject by Scarpa, are not entertained by the generality of surgeons; or rather, his doctrine is not carried by others to the extent which he has insisted upon, and it would be useless repetition to bring again before the reader the facts, proving that his statements are liable to many exceptions. A case, however, recited by M. Roux, which I have met with since the foregoing pages were printed, merits notice; it was an instance, in which a popliteal aneurism, unattended with pulsation, had been mistaken for an abscess and punctured, whereby the patient lost his life. On dissecting the limb, M. Roux says, "the three coats of the artery participated in the dilatation, and the case was one of the clearest specimens which I have ever seen of a true aneurism." (*Nouveaux Elémens de Méd. Opératoire*, t. i. p. 517.)

The best pathologists now admit six varieties of aneurismal disease of the aorta. 1. *A Dilatation*, involving the whole circumference of the artery. 2. *True aneurism*, or a sacculated dilatation of only a portion of its circumference. 3. *False aneurism*, formed by ulceration, or rupture of the internal and middle coats, and a dilatation of the external one into a sac. 4. *Mixed* or *sacculated aneurism*, where, after partial, or general dilatation, of all the three coats, the internal and middle burst, and the external alone expands into another sac, engrafted as it were upon the original dilatation, or true aneurism. 5. The case, in which the inner coat protrudes through the outer ones. (*Dubois; Dupuytren; Laennec, De l'Auscult.* t. ii. p. 693.) A fine specimen of this is contained in Mr. Liston's collection. 6. A few very rare examples have been noticed, in which, after the rupture of the internal and middle coats of the aorta, the blood, instead of distending the external coat into a swelling, insinuates itself more or less extensively between this coat and the middle one. Thus Laennec saw a case, in which the internal and middle coats had a narrow fissure in them extending across two thirds of the circumference of the artery; and the blood had interposed itself between the external and middle coats, over more than half of the circumference of the aorta, from its arch to its bifurcation. (*Laennec, De l'Auscult.* t. ii. p. 700.) Two similar cases are reported by Mr. Guthrie. (*On Dis. of Arteries*, p. 40. and 43.) The late Mr. Shekelton met with a still more curious form of aortic aneurism, where the blood, after making its way through the internal and middle coats, had separated the external from the middle to the extent of four inches, and then passed again through the middle and internal coats into the canal of the artery; thus forming a new channel, and the old one being obliterated. (*Shekelton*, in *Dubl. Hosp. Rep.* vol. iii.)

As Dr. Hope observes (*Cyclop. of Pract. Med.* art. *Aorta*), the foregoing are the only instances on record, where a fissure of the internal and middle coats has been followed by more than a circumscribed effusion of blood around it, occasioning a slight swelling of the external coat. Nichols found this in the body of George II. (*Phil. Trans.* vol. lii. p. 269.); and Hodgson once met with it. (*On Dis. of Arteries*, p. 63.)

Aneurisms, and the diseases of the coats of the arteries which precede their formation, are well known to be far more common in men, than women. (*Sir A. Cooper, Hodgson, Lisfranc*, &c.) Yet, women are perhaps quite as frequently afflicted with aortic aneurisms as men, though, with respect to external aneurisms, they may only exhibit the proportion of one case to fifteen or twelve in male subjects. (See *Hope*, in *Cyclop. of Pract. Med.* art. *Aorta.*) With respect to dilatation, affecting the whole circumference, I may observe, that the great arterial trunks, given off at right angles from the aorta, as the innominata and cœliac axis, generally participate in it; but, as Laennec observes, the left subclavian commonly remains unaffected, on account of the acute angle, at which it leaves the arch of the aorta.

As for *true aneurisms*, almost all those of the ascending aorta and arch are originally of this description; but the false is sometimes engrafted upon them. The tumour, which mostly inclines to the right side of the chest, generally springs from the anterior or the lateral part of the vessel, while the posterior is little, if at all, implicated. When it springs from the root of the aorta, and the middle and internal coats give way, the consequence is not a false aneurism, surmounting the true, as in other parts, but a fatal extravasation into the pericardium. The reason of this is, that the portion of the aorta referred to, is destitute of the cellular coat, and the pericardium, which supplies its place, not being equally extensible, bursts while the aneurism is but of small size. (See *Scarpa on Aneurism, by Wishart*, p. 80.; *Hope* in *Cyclop. of Pract. Med.* art. *Aorta; Bertin, Bouilland*, &c.) It does not appear certain to me, that the preparation, No. 367. in the Hunterian collection at the College of Surgeons, proves, as Mr. Guthrie believes it does (*On Dis. of Arteries*, p. 70.), that this doctrine is incorrect, because, though it is true that the aneurism, in this instance, is of unusual size, the inner membrane can be distinctly seen passing over the atheromatous patches. As Dr. Hope remarks, the preparation is then not one of false *aneurism*, as the middle coat is perfect, the internal one alone being removed or diseased (it is doubtful which), at the base of the sac. Scarpa only maintains, that the pericardium becomes incapable of resisting a false extravasation after the inner coats have given way.

In the Museum of the London University, the preparation No. 616. exhibits three diminutive aneurismal sacs just above the valves of the aorta, one of which has burst into the pericardium. The preparation No. 617. in the same collection, is the heart of a patient who died of the rupture of a small aneurism within the pericardium. He had been operated upon for a popliteal aneurism only three months previously. The little tumour burst just above the pulmonary artery, and a bristle is passed through the opening from the inside of the aorta, where the sac is seen directly above the valves. We know that in one case, when Sir Astley Cooper had just commenced the operation for popliteal aneurism, the patient suddenly expired, owing to a small aneurism near the root of the aorta happening to burst into the pericardium at this moment of agitation and suffering.

In thin subjects, the throbbing of the abdominal aorta is sometimes unusually plain through the integuments and viscera, and this has occasionally given rise to the suspicion of an aneurism; a circumstance, which deserves to be remembered by every surgeon, desirous of not pronouncing a wrong opinion. The preternatural pulsations, however, which are liable to be mistaken for those of aortic aneurisms, are of various kinds, and form a subject, to which the attention of Dr. Albers of Bremen, the late Mr. A. Burns, and others, has been very usefully directed. (See ABDOMEN.)

While thoracic aneurisms of the aorta are not accompanied by external swelling, the symptoms are all equivocal, as very similar ones may depend on a disease of the heart, angina pectoris, phthisis pulmonalis, &c. However, some difference depends upon the volume, position, and nature of the aneurism. Simple dilatation, when in a moderate degree, hardly produces any effect, but the most inconsiderable false aneurisms may give rise to very serious disorder. The first and most common of these effects is, the compression of the heart and lungs. (See *Laennec on Diseases of the Chest, by Forbes*, p. 676. ed. 2.) Amongst its worst effects are those which it produces on the trachea and bronchi; for, though the pressure be slight, it often suffices, in consequence of the great irritability of these parts, to produce considerable dyspnœa. It must not be imagined, however, that dilatation is an unimportant affection; for, when complicated with hypertrophy of the heart, it is one of the most formidable diseases of the organs of the circulation. (See *Hope*, in *Cyclop. of Pract. Med.* art. *Aorta.*)

The only unequivocal general sign of an aneurism of the thoracic aorta, is a tumour, presenting itself externally, and attended with an expansive heaving pulsation, synchronous with the action of the heart. Many of the other general signs are acknowledged to be like those of organic disease of the heart; viz. palpitation, dyspnœa, cough, tendency to syncope, terrific dreams, starting from sleep, hæmoptysis, livid complexion, cerebral or hepatic congestions, serous infiltration, &c. The identity of the general signs arises, as Dr. Hope explains, from an identity of cause; namely, an obstacle to the circulation, which depends either upon the aneurism alone, or conjointly upon it and a disease of the heart, to which, sooner or later, the aneurism almost invariably gives birth. When, however, the general signs coincide with those learned by auscultation, they lose their ambiguity. (See *Hope*, in *Cyclop. of Pract. Med.* art. *Aorta.*)

In aneurism of the aorta, forming a defined tumour, violent and irregular throbbings frequently occur between the fourth and fifth true ribs of the left side; the same irregularity of the pulse prevails as often proceeds from organic affections of the heart; sometimes a dissimilarity of the pulses in the two wrists, an effect depending upon obstruction, or obliteration of the arteria innominata or left subclavian; the respiration is exceedingly obstructed; the voice altered; and in a more advanced period of the malady, the patient is at times almost suffocated, or actually perishes from this cause. The pressure of the internal swelling on the trachea, bronchi, and lungs, is sufficient to account for this difficulty of breathing. When the trachea, or primary bronchial divisions, are compressed by an aneurismal tumour, a harsh wheezing, or sibulous sound, characterizes respiration; and when the heart is simultaneously diseased, dyspnœa sometimes occurs in most severe paroxysms, threatening suffocation. (See *Hope, Op.* cit.) In many instances, the irritation and compression, produced by the tumour, occasion atrophy of the greater part of the lungs, and abscesses and induration throughout the portion which remains. The function of deglutition suffers interruption, in consequence of the pressure made on the œsophagus, which may even be in a state of ulceration. Thus, in one example, "the cavity of the windpipe was nearly obliterated from the pressure of the aneurism; and the extremities of four of its cartilages lay in the œsophagus, having entered that canal through an ulcer in its coats." (*Trans. for the Improvement of Med. and Chir. Knowledge*, vol. iii. p. 83.) After what has been stated, it cannot be surprising, that ere the disease manifests itself externally, affection of the lungs, or strictures of the œsophagus, should often be suspected. (*Hodgson*, p. 91.; *Porter*, in *Dubl. Journ. of Med. Science*, vol. iv. p. 207.) On the supposition of a stricture in the œsophagus, probangs have frequently been used.

The greater weakness of one radial pulse than the other, or its total extinction, may proceed from a variety of causes, independent of aneurism of the aorta, as contraction of the origin of either of the subclavian arteries from calcareous, cartilaginous, steatomatous, or other depositions; obstructions in the course of the artery produced by tumours, wounds, or subclavian aneurism, or from an irregular subdivision of the radial or brachial artery. (See *Hope*, in *Cyclop. of Pract. Med.* art. *Aorta.*)

An aneurism of the arteria innominata, not discovered till after the patient had died of suffocation, gave rise to great difficulty of drawing air into the chest, without any other symptom calculated to throw light on the nature of the disease. The aneurismal swelling was situated behind the first bone of the sternum, and pressed upon the trachea. The front of this tube was pushed in by the tumour, so as to present a convex prominence on the inner surface, which, however, diminished its area in a very slight degree. Mr. Lawrence adduces this fact to prove, that spasm of the air-cells may be the cause of great distress in breathing. "The termination of this case (says he) is the more remarkable, inasmuch as in another patient an aneurism rising out of the arch of the aorta, and pressing on the corresponding part of the trachea, so as to produce ulceration of the internal membrane, under which there was a slight appearance of coagulated blood, caused no affection of the breath at all. The person died of a different complaint, and the discovery of the aneurismal tumour, which was very small, and filled with firm laminated coagula, was quite accidental." (*Med. Chir. Trans.* vol. vi. p. 227.) Thus, we find in thoracic aneurisms, at least previously to their attainment of a certain size, that no regularity prevails even with regard to difficulty of breathing, the symptom, which, *à priori*, one might suppose would invariably be present.

One of the least equivocal signs of an aneurism of the thoracic aorta, is a pulsation felt under the sternum, or ribs, at the upper part of the chest. But, a positive opinion is not to be formed from this symptom alone, which has been known to be occasioned by some other kind of tumour behind the sternum, by adhesion of the pericardium to the heart, by fluid in the cavity of this membrane, and by hypertrophy of the heart. (*Baillie's Morbid Anat.*; and *Hope*, in *Cyclop. of Pract. Med.* art. *Aorta.*) Then another symptom of aneurism of the thoracic aorta, is pulsation above the sternum or clavicles. But this may also proceed from enlarged glands in the course of the subclavian artery, and receiving its pulsation; by varix of the jugular vein at its junction with the subclavian; or by a subclavian aneurism. A gentleman, under Mr. Maul, of Southampton, lately consulted me for a considerable throbbing felt above the sternum and clavicles, and which had been suspected to denote on the left side a subclavian aneurism. The radial pulse in the left arm was rather weaker than in the left. But the carotids also pulsated with unusual force a good way up the neck; and every little exertion brought on powerful beating of the heart. In a consultation with Sir Astley Cooper, these circumstances led us to set down the case as one of dilatation of the great arteries at the source of the circulation, with an imperfect state of the valves, and some degree of hypertrophy. A pulsation above the sternum may be occasioned by carotid aneurism, which is liable to be confounded with aneurism of the aorta, or of the subclavian artery. Dr. Hope informs us, that in April, 1826, he saw in Guy's Hospital a case, which led to much deliberation, respecting the propriety of taking up the carotid above a pulsation tumour, supposed to be an aneurism of that artery. The plan, however, was judiciously abandoned, for the disease proved to be a dilatation of the aorta and innominata. (See *Hope* in *Cyclop. of Pract. Med.* art. *Aorta.*)

Few diseases, according to Laennec, are so insidious as aneurism of the thoracic aorta. He affirms, "that it cannot be known with certainty till it shows itself externally. It can hardly be suspected, even when it compresses some important organ, and greatly deranges its functions. When it produces neither of these effects, the first indication of its existence is often the death of the individual, as instantaneously as if by a pistol-bullet." One case, recorded by Mr. Pattison, confirms the same fact, for the patient had only symptoms leading to a suspicion of rheumatism in the neck, and died suddenly of apoplexy. (*Burns on the Head and Neck, ed. by Pattison.*) Laennec has known persons cut off in this manner, who were believed to be in the most perfect health. He admits, that percussion will sometimes enable us to detect a tumour of large size, existing within the mediastinum, or even in the back; but not to discriminate the nature of the swelling. His experience had not been sufficient to let him pronounce how far the difficulty of diagnosis was likely to be removed by the stethoscope. Dr. Hope has met with six or seven instances, in which large aneurisms had existed, without awakening even a suspicion of them. One, in particular, eluded the penetration of a distinguished foreign auscultator, though he explored the lungs with eminent success. (*Hope* in *Cyclop. of Pract. Med.* art. *Aorta.*) Aneurisms of the abdominal aorta, Laennec admits, may be recognised with the utmost facility by means of the stethoscope. In this case, we are sensible of tremendous pulsations, which painfully affect the ear, and the intensity of which is not at all recognised by the hand, even when sufficiently perceptible to the touch. As high up as the cœliac artery, the contractions of the auricles are not in the least distinguishable. The sound of the pulsations is clear and loud. (*Laennec on Diseases of the Chest*, p. 678, &c.)

Laennec believed, that thoracic aneurism might sometimes be recognised by its *simple* or rather *single* pulsation, which is much stronger than the double pulsation of the heart; but that, in most instances, this criterion would fail, in consequence of the sound of the heart and that of the aneurism being confounded together. But as the auricular sound is not audible over the abdomen, Laennec had no difficulty in recognising ventral aneurism by the *simple* pulsation. The following are some of the criteria, specified by Dr. Hope, for distinguishing the pulsation of thoracic aneurisms from the beating of the heart; and, in some important points, his observations have received confirmation from the experience of Dr. Greene. (See *Researches on the Symptoms, &c. of Aneurisms of the Thoracic Aorta, Dubl. Journ. of Medicine*, vol. vii. p. 231.) 1. The first aneurismal sound, coinciding with the pulse, is invariably louder than the healthy ventricular sound, and generally than the most considerable bellows-murmurs of the ventricles. 2. On exploring the aneurismal sound from its source towards the region of the heart, it is found to decrease progressively, until it either becomes totally inaudible, or is lost in the predominance of the ventricular sound. If the sound emanated from the heart alone, instead of decreasing, it would increase, on approximating the præcordial region. 3. The second sound actually does sustain this progressive augmentation on advancing towards the heart. 4. The aneurismal pulsation is a deep, hoarse tone, of short duration, with an abrupt commencement and termination. It is compared to that of the rasping of a sounding board heard from a distance. But the sound, occasioned by valvular disease of the heart, has more analogy to the bellows-murmur, being somewhat soft and prolonged, with a gradual swell and fall. 5. In simple dilatation of the thoracic aorta, the *frémissement cataire*, or purring tremor, is more considerable than in sacculated aneurism, particularly if the former be accompanied with much asperity of the internal membrane. It is also very correctly noticed by Dr. Hope, that the sound of aneurisms is, in most instances, audible on the back; and when the tumour occupies the descending aorta, it is often louder behind than on the breast; and if it is of the abrupt rasping kind, it amounts almost to positive evidence. Pulsation, he observes, attends every species of enlargement of the aorta. In dilatation, it exists only above the sternal ends of the clavicles, and always on both sides of the neck simultaneously; though, when the enlargement is confined to the ascending aorta, it is stronger on the right than on the left side. When dilatation is in the form of a pouch, and of great magnitude, it may occasion pulsation under the sternum. Carotid and subclavian aneurisms produce impulse, sound, and tremor, on the affected side only; and by this circumstance, they may easily be discriminated from aortic enlargements. In sacculated aneurisms in the upper part of the chest, pulsation exists both above and below the clavicles; but Dr. Hope has generally found it stronger below. (*Hope*, in *Cyclop. of Pract. Med.* art. *Aorta.*) M. Bertin also believed, as Dr. Hope does, that Laennec underrated the power of the stethoscope to detect aneurism of the thoracic aorta. (*Mal. du Cœur*, p. 143.) Still, it is a fact, that, even with the assistance of this instrument, thoracic aneurism sometimes cannot be detected, and produces symptoms, leading to a suspicion of other affections, to which the treatment is directed accordingly. (See *Porter*, in *Dubl. Journ.* vol. iv. p. 206, &c.)

I have mentioned, that the symptoms of thoracic aneurisms, previously to the formation of any outward swelling, often resemble those of phthisis, and the latter is sometimes actually supposed to be the disease under which the patient is labouring. But, there is one distinction between the cases, pointed out by Mr. Hodgson, which may be of use, in combination with other circumstances, in facilitating the diagnosis: "In phthisis, the expectoration is either puriform, or thick and clotted; but, in aneurisms which are not accompanied with disease in the lungs, as far as I have observed, it always consists of a thin frothy mucus." (*On Dis. of Arteries, &c.* p. 93.) According to Kreysig's experience, the cough comes on at irregular periods, is violent, and attended with great efforts, the expectorated matter being forced up with vehemence. He agrees with Mr. Hodgson, respecting the general quality of what is expectorated, where thoracic aneurisms are not complicated with diseased lungs; but, he says, that the matter coughed up also frequently consists of masses of lymph, blended with brick-red particles of blood, which masses, when thrown into water, seem as if they were composed of a ball of stringy substances. (*Germ. transl. of the latter work*, p. 137.)

From a review of many cases of aortic aneurisms, Mr. A. Burns was inclined to think, that when the ascending aorta is aneurismal, the breathing is more affected than when the arch of the vessel is enlarged; but that, in the latter case, the impediment to deglutition is greatest. (*On Dis. of the Heart, &c.* p. 244.)

False aneurisms are most common in the descending aorta, and true ones in the ascending portion of the vessel and its arch. Laennec never met with any species of false aneurism in the latter situation, but such as is consequent to the true, or simple dilatation of the artery. (*On the Dis. of the Chest*, p. 676. *ed. by Forbes.*)

The way, in which aneurisms of the thoracic aorta prove fatal, is subject to considerable variety. These swellings do not always destroy the patient by hemorrhage: in numerous instances, the functions of the lungs, bronchi, heart, and œsophagus are so deranged by compression, that death is induced, and not a drop of blood is found internally effused. Frequently (to use the description of Mr. John Bell) before the awful and fatal hemorrhage has had time to occur, the patient perishes of sufferings too great for nature to bear. The aneurismal tumour so fills the chest, oppresses the lungs, compresses the trachea, and curbs the course of the descending blood, that the system, with a poor circulation of ill-oxydated blood, is quite exhausted. And, thus, though the patient is saved from the most terrible scene of all, he suffers great miseries; he experiences in his chest severe pains, which he compares with the stabbing of knives; terrible palpitations; an awful sense of sinking within him; a sound within his breast, as if of the rushing of waters; a continual sense of his condition; sudden startings during the night; fearful dreams and dangers of suffocation; until, with sleepless nights, miserable thoughts by day, and the gradual decline of an ill-supported system, he grows weak, dropsical, and expires. (See *Anatomy of the Human Body, by John Bell*, vol. ii. edit. iii. p. 234, 235.) Cruveilhier relates the particulars of one very interesting case of aortic aneurism, where two swellings existed, one of which had pressed so strongly on the pneumo-gastric nerve, as entirely to have disorganised a portion of it. The patient suffered frequent syncopes, and died from general derangement of the pulmonic and gastric functions, and not from the rupture of the aneurism, which, however, if the patient had lived a little while longer, would have burst into the trachea, the mucous membrane of which was ulcerated in more places than one. (See *Cruveilhier, Anat. Pathol.*) In this example, the left subclavian vein had been rendered impervious by the pressure of the swelling.

Mr. A. Burns saw two examples, in which the patients died instantaneously, though their aneurismal tumours were very small, and had not burst. Both these patients were in the early stage of pregnancy. (*On Diseases of the Heart*, p. 236.)

The situations in which aneurisms of the curvature of the aorta burst, are different in different cases. Sometimes the swelling bursts into the cavity of the chest, or that of the pericardium, and the patient drops suddenly down. The left cavity of the pleura is by far the most frequent situation in which thoracic aneurisms of the aorta burst. (*Laennec on Dis. of the Chest*, p. 677.) They also frequently burst into the posterior mediastinum. They rarely open into the cavity of the right pleura. When the coats of the aorta give way within the pericardium, where they only receive a slight external membranous covering, this is apt to be also ruptured at the same time, so as to bring on copious effusion of blood, which oppresses the action of the heart, and produces immediate death. In other examples, the blood is effused into the trachea, or bronchi; and the patient, after violent coughing and ejections of blood from the mouth, expires. Sometimes, after the tumour has become closely adherent to the lungs, it bursts into the air-cells, through which the blood is widely diffused. An example of this termination of the disease was observed by Laennec; who also saw another case, in which, if the patient had lived a little longer, the same occurrence in all probability would have happened. Ehrhardt is not aware, that this mode of rupture has been noticed by other writers. (*De Aneurysmate Aortæ*, p. 21. 4to. Lips. 1820.)

Amongst the most remarkable local effects of aneurisms of the aorta, are those on the vertebral column. They often destroy it to a very great depth. This is entirely the work of interstitial absorption, there never being any mark of suppuration. On the side next the vertebræ, the sac is completely destroyed, and the circulating blood is bounded by the naked bone. In certain cases, the swelling beats its way through the ribs; even the spinal marrow may be injured, and the patient suffer a species of death, somewhat less violent and sudden. In one case of an enormous aneurism of the abdominal aorta, reported in No. 259. of the *Lancet*, the left leg and thigh were much wasted, and quite paralytic. This seemed to arise, however, from the pressure on the nerves of the lower extremity, and not from injury of the medulla spinalis.

The preparation No. 623. in the Museum of the London University, is an aneurism of the aorta, which made its way through the ribs, destroying part of them and the lateral portion of the spine, so as to expose the medulla. The tumour presented itself below the scapula, and burst into the trachea by an ulcerated opening near its bifurcation. In the Hunterian Collection is a large aneurism of the commencement of the descending aorta, which caused the absorption of parts of several of the ribs, and of the bodies of the fourth and fifth dorsal vertebræ, the aneurism forcing its way there into the spinal canal. (See *Guthrie on Dis. of Art.* p. 96.)

The effect of aneurism in producing absorption of the osseous texture, while the intervertebral substance remains little or not at all injured, is noticed in the previous part of this article.

But, although aneurisms in the chest do sometimes protrude at the back, a circumstance that depends on the particular situation of the disease (see *Pelletan, Clinique Chir.* t. i. Obs. 7. p. 84.), they more commonly rise towards the upper part of the breast, where a throbbing tumour occurs, which has caused an absorption of the opposing parts of the ribs and sternum, and sometimes dislocated the clavicle. Corvisart saw an instance, in which an aneurism of the aorta had dislocated the sternal extremity of the clavicle; and Duverney makes mention of a case, in which besides the displacement and injury of the clavicle, the sternum and scapula were partially destroyed. I attended a case with Dr. Pinckard, where an aortic aneurism had produced considerable displacement of the scapula. Guattani speaks of an example, in which the clavicle was bent by a large aneurism, of which a portion, as large as a pigeon's egg, projected above the bone. (*Lauth*, p. 168.) And Morgagni has described a case, where the upper bone of the sternum, the sternal ends of the clavicles, and the adjoining ribs, were destroyed by the pressure of a large aneurism of the front of the curvature of the aorta, and the disease presented itself externally, somewhat in the form of a boil. (*Epist.* 26. art. 9.)

The swelling now pulsates in an alarming way. The blood is only retained by a thin covering of livid skin, which is daily becoming thinner and thinner. At length, a point of the tumour puts on a more conical, thin, and inflamed appearance than the rest; a slough is formed, and, on this becoming loose, the patient is sometimes instantaneously carried off by a sudden gush of blood.

An extraordinary case of aneurism of the aorta is related by Dr. C. W. Wells. The disease, being unattended with any external swelling, it seems, was not comprehended during the patient's lifetime.

The following is an abstract of the case. Mr. A. B., a gentleman thirty-five years of age, and temperate in his habits, became affected in 1789 with symptoms, which were thought to denote the approach of pulmonary consumption. These, however, after some time, entirely disappeared. In 1798, he was attacked with a slight hemiplegia, from which he also recovered, with the exception of an inconsiderable sense of coldness in the foot, which had been paralytic. In March, 1804, he complained of being frequently troubled with a noise in his ears, flatulence in his bowels, and pains in his hands and feet, sometimes attended with slight swellings in the same parts. From one, or more of these symptoms, he was never afterwards quite free; but, he did not complain of any unusual feelings in his chest.—August 11. 1807, he fatigued himself considerably with walking; ate rather a hearty dinner; and, having refreshed himself with some sleep afterwards, he played about with his children. While thus amusing himself, he was suddenly seized, between eight and nine o'clock, with great oppression in his chest. He soon afterwards became sick, and, in the matter thrown up, some streaks of blood were observed. He now went to bed; but, though the weather was warm, and he was covered with bed-clothes, his skin felt cold to the attendants. At midnight, he laboured under a constant cough, and expectorated mucus tinged with blood. His body was moistened with a cold sweat, and his pulse was extremely feeble; sometimes it was scarcely perceptible. About five in the morning, his pulse was feeble and irregular; his breathing difficult, his skin pale and cold, and covered with a clammy sweat. He frequently tossed and writhed his body, as if he was suffering great pain or uneasiness. The mental faculties, however, seemed unimpaired. Shortly afterwards he expired, having complained, just before his death, of much heat in his chest, and thrown off the bed-clothes.

The most remarkable circumstance, found on opening the body, is thus recorded:—"The ascending aorta was distended to about the size of a large orange. The tumour adhered to the pulmonary artery, just before its division into the right and left branches. Within the circumference of this adhesion, there was a narrow hole, by means of which a communication was formed between the two arteries."

Dr. Wells concludes with observing, that, though such a disease might easily have been imagined, he had found no instance of it in books, and that it had not been observed by any of the surgeons or anatomists in London. He supposed, that the communication between the aorta and pulmonary artery took place on the evening before the patient's death, when the oppression of the chest was first felt; and that, in consequence of the superior strength of the left side of the heart, a part of the blood which was thrown into the aorta must have been forced into the pulmonary artery, from which circumstance he conjectures most of the symptoms originated. (*Trans. of a Society for the Improvement of Med. and Chir. Knowledge.* vol. iii. p. 85.)

MM. Payen and Zeink met with another instance of the rupture of an aneurism of the aorta into the pulmonary artery. (*Bulletin de la Faculté de Méd.* 1819, No. 3.) And Dr. Hope informs us, that Professor Monro, tertius, showed him a preparation of an aneurismal pouch, springing from the aorta, directly against the pulmonary artery; so that, if the patient's life had been prolonged, the aneurism would probably have burst into the latter vessel. (*Hope, in Cyclop. of Pract. Med.* art. *Aorta.*) In the Hunterian Collection at the Royal College of Surgeons in London is a preparation, No. 366., exhibiting a sacculated aneurism of the ascending part of the aorta, and a communication formed between the nipple-like portion of the tumour and the pulmonary artery by ulceration, immediately above and between two of the sigmoid valves. (*Guthrie on Dis. of Art.* p. 60.)

Some additional examples of this nature are detailed by other writers. (See *Bulletin de la Faculté de Médicine,* No. 3., in which there are two cases; *Sue,* in *Journ. de Méd. continué,* t. xxiv. p. 124.; and *Bulletin de la Faculté, &c.* t. xvii. p. 16.)

Aneurisms of the arch of the aorta are stated to have adhered to, and burst into, the right auricle of the heart, and thus to have produced instant death. (See *Med. Chir. Journ.* vol. vi. p. 617.; *Bulletin de la Société de Médecine à Paris,* 1810, No. 3. p. 38.)

A case, in which an aortic aneurism projected into the ventricles of the heart, is described in a modern publication. (See *Dublin Journ. of Med. Science,* No. 27.)

The cases recorded, in which aneurisms of the thoracic aorta have burst into the œsophagus, are beginning to be more numerous than formerly. Bonetus and Morgagni relate no examples of it; nor are there any in the comprehensive treatises of Scarpa and Hodgson. Corvisart speaks of an instance, which had been seen by Dupuytren, of which, however, no description is given. Yet the possibility of the occurrence is not a matter of speculation, or doubt. A case of this description is noticed by Matani (*De Aneurism. Præcordiorum Morbis,* p. 120.); another is alluded to by Ehrhardt, as being related by Copeland (*Comment. de Aneurismate Aortæ,* p. 22.; *Cerutti Catal. Prop. Pathol.*); an instance is described by Bertin (see *Bulletin de la Faculté de Méd.* 1810, p. 14.); and a very interesting one, attended with disease of the spinal cord and paralysis, is given by Dr. Molison. (See *Edin. Med. Chir. Trans.* vol. iii. p. 173.)

I have recorded one example myself (see *Med. Chir. Trans.* vol. xvi.) This was remarkable for the length of time which the patient lived after the first rupture of it, and on account of the diminution of the external swelling and of the displacement of the scapula.

Sauvages is one of the writers who have adduced proofs of this mode of rupture: *Cadavere aperto, inveni ventriculum septem vel octo libris sanguinis distensum, aortam ad brachii magnitudinem, per spatium septem vel octo pollicum dilatatam, et orificium denarii magnitudine aortæ et œsophago continuo commune, quod tamen quinque cristæ carneæ, veluti valvulæ ex ambitu orificii oriundæ et circumpositæ potuerunt obturare. Per hoc orificium, sanguis ex aorta fluxerat in œsophagum.* (*Nov. Method,* t. ii. p. 298.) A similar case was published by Brichetau. (See *Bulletin de l'Athenée de Méd. de Paris,* Dec. 1816.) Laennec met with three examples of death from this cause. (*On Dis. of the Chest,* p. 677. *ed. by Forbes.*) The same distinguished professor met with an aneurism of the descending aorta, where the tumour had made such pressure on the thoracic duct, that this tube was partly destroyed, and all the lymphatic vessels were found uncommonly turgid. (*Journ. de Méd. par Corvisart,* t. ii. p. 15.) With the exception, perhaps, of one instance given on the authority of Lancisi (*Lauthii Collect.* p. 38.), no other example of this description is upon record.

An instance is reported by Corvisart, in which the pressure of an aneurism of the ascending aorta had nearly obliterated the termination of the lower vena cava, and a fatal attack of apoplexy was the consequence. (*Mal. du Cœur,* p. 342.) Other examples of this are reported by Corvisart, Bertin, and Dr. Hope.

Aneurisms of the arch of the aorta may occasion a tumour, so much like that of a subclavian aneurism, as to be in danger of being mistaken for the latter disease. An example of this kind is related by Mr. Allan Burns: "A case," says he, "on which several of the most distinguished practitioners of Edinburgh, and almost every surgeon in Glasgow, were consulted. The nature of the disease appeared to be so decided, and its situation in the subclavian artery so clear, that, on that subject, there was no difference of opinion. Some were, however, of opinion that an operation might be performed, while others were fully convinced that the case was hopeless. For myself, I must confess, that I was firmly persuaded, that, in the early stage of the disease, an operation might have been beneficial," &c. (*Surgical Anatomy of the Head and Neck,* p. 30.) After death, the vessel, which was supposed to have been most materially affected, was found perfectly healthy. (P. 39.)

After detailing all the particulars of this interesting case, Mr. A. Burns observes, that "it corroborates Sir Astley Cooper's remark, that aneurism of the aorta may assume the appearance of being seated in one of the arteries of the neck; an inference, drawn from the examination of a case, which came under his own observation, and of which he had the goodness to transmit a short history to me, along with a sketch, illustrative of the position of the tumour. In one case the aneurism was attached to the right side of the aortic arch, and involved a part of the arteria innominata; in Sir A. Cooper's, the tumour arose from the left side of the arch, from between the roots of the left subclavian and carotid arteries. It formed a Florence-flask-like cyst, the bulbous end of which projected at the root of the neck from behind the sternum, and so nearly resembled aneurism of the root of the carotid artery, that the practitioner, who consulted Sir A. Cooper, actually mistook the disease for carotid aneurism." (*Allan Burns, Op.* cit. p. 41.)

The preceding statement has received full confirmation from the observations of an intelligent writer. "I have seen (says Mr. Hodgson) several cases of aneurism arising from the superior part of the arch of the aorta, which protruded above the sternum and clavicles, and, in one instance, the space between the tumour and the sternum was so considerable, that it was proposed to tie the carotid artery for an aneurism, which dissection proved to arise from the origin of the arteria innominata, and from the arch of the aorta." (*On the Dis. of Arteries and Veins*, p. 90.)

As I have already noticed, aneurisms of the aorta are most frequent at its curvature; but they are also met with on the other portion of this vessel in the thorax, and likewise on that part of it which is below the diaphragm. In subjects, predisposed to aneurisms, such swellings are frequently seen affecting various parts of the aorta at the same time.

When the disease occurs in the abdominal aorta, a preternatural pulsation generally becomes perceptible at some particular point. The pressure of the tumour disturbs the functions of the viscera. The functional derangements, however, produced by aneurisms of the abdominal aorta, are generally much less urgent, than those arising from aneurism in the thorax. The abdominal viscera bear compression without evil consequences, much better than the thoracic ones; and the tumour, instead of being pent up in a rigid bony case, like the chest, are not prevented from expanding freely, in almost every direction, because the intestines and the abdominal parietes readily yield in the requisite degree. As Dr. Hope observes, here the pressure of the tumour on any particular organ, is in a great measure obviated by the want of counterpressure. "Ventral aneurism, however, sometimes deranges the respiration, by preventing the due descent of the diaphragm; an effect, which may proceed either from the magnitude alone of the tumour, or, what is much more common, from its being seated near or in the substance of the muscle, and impeding its motions. Ventral aneurism is also occasionally characterised by involuntary evacuations of the urine and fæces, by remarkable alternations of constipation and diarrhœa, and by deep-seated excruciating pains, resembling those of lumber abscess. These symptoms arise from compression of the nerves, particularly the hypogastric plexus around the aorta." (See *Hope, in Cyclop. of Pract. Med.* art. *Aorta.*)

In the museum of the London University are several valuable preparations, illustrative of aneurism of the abdominal aorta. No. 619. is an aneurism of this vessel, implicating the mesenteric and venal arteries. No. 621. is an aneurism of the aorta at its bifurcation. No regular sac. Tumour extends down over the forepart of the sacrum. Vena cava obliterated at the point where it receives the two iliac veins. No. 622. is an aortic aneurism, consisting of two large sacs at the sides of the lumbar vertebræ, the texture of whose bodies is more or less destroyed, while the intervertebral substance is entire. During life, the disease was not suspected. The patient suffered excruciating pain in the lower part of the belly. A few days before death, a large tumour presented itself on the left side of the abdomen, with symptoms of internal hemorrhage. In the *post mortem* examination, blood was found between the abdominal muscles and the peritoneum, and the viscera were covered with coagula. The tumour had burst in two places on the right side. The shape of the kidneys was altered by the pressure of the tumour, which adhered to the spleen and pancreas. No. 625. is an aneurism of the aorta, where it passes between the crura of the diaphragm, and projecting into both sides of the chest; while a portion of it, on the right side, descends into the abdomen. The bodies of the vertebræ partly absorbed. Death from effusion of blood into the chest.

Aneurisms, within the thorax and abdomen, being entirely out of the reach of operative surgery, have been too commonly abandoned as unavoidably fatal, and when any thing has been done in such cases, it has generally been only with a view to palliation. Moderating the force of the circulation by bleedings and low diet, avoiding every thing that has the least tendency to heat the body, or quicken the motion of the blood, keeping the bowels well open with laxative medicines, and lessening pain with opiates, have been the means usually employed. Of late years, also, digitalis, which has a peculiar power of diminishing the action of the sanguiferous system and impetus of the blood, has been commonly prescribed. In Germany, the superacetate of lead has been used for many years, for the same purpose; and Dupuytren, Laennec, and Bertin have employed it frequently with advantage in France. The dose, at first, should be half a grain, combined with the same quantity of opium, and given thrice a day. The dose is gradually increased to a grain three or four times a day. Dr. Hope informs us, that he has always found any gastric irritation from it removed by a dose or two of castor oil, promptly administered, and mucilaginous diluents. (See *Cyclop. of Pract. Med.* art. *Aorta.*)

That the diminution of the force of the circulation will prevent the increase of an aneurism, Mr. Hodgson considers illustrated by the following circumstance: If two sacs exist in the course of the same artery, the obstruction, which is caused by the passage of blood into the upper, serves to remove the force of circulation from the lower, which becomes stationary, or its cavity is obliterated with coagulum. (*On Diseases of Arteries, &c.* p. 149.) Mr. Crosse refers to a recent case, in which a popliteal aneurism was cured by another aneurismal swelling taking place in the thigh. The latter was afterwards cured by an operation. (See *Prov. Med. Surg. Trans.* vol. v.)

It was the opinion of the celebrated Valsalva, that the utility of a lowering plan of treament might do more than merely retard the death of aneurismal patients. It was his belief, that the method might entirely cure such aneurisms as had not already made too much progress; and he put it into practice with such rigour and perseverance, that the treatment became considered as particularly his own. The plan alluded to is not described in his writings, but was published in the first volume of the Commentaries of the Academy of Bologna, by Albertini, one of his fellow students; and several persons, who had learned this method of Valsalva, afterwards imparted it to others. Thus, as Morgagni was passing through Bologna, in 1728, Stancazi is said to have informed him of Valsalva's practice. (See *Kreysig, Ueber die Herzkrankheiten,* b. ii. p. 728.)

After taking away a good deal of blood by venesection, Valsalva used next to diminish the quantity of food gradually, till the patient at length was allowed only half a pint of soup in the morning, and a quarter of a pint in the evening, and a very small quantity of water, medicated with mucilage of quinces, or with the lapis osteocolla. When the patient had been so reduced as to be incapable of getting out of his bed, Valsalva used to give him more nourishment, till this extreme debility was removed. Valsalva was sure that some aneurisms, thus treated, had got well, because every symptom disappeared; and his conviction was verified by an opportunity, which he had of dissecting the body of a person that had been cured of this disease, and afterwards died of another affection; for the artery, which had been dilated, was found contracted, and in some degree callous.

Morgagni states, that this method of treating aneurisms is somewhat like the plan, which Bernard Gengha tried with success, as well as Lancisi; and he refers us to the 24th chapter of the 2d vol. of the Anatomy of the one, and to lib. ii. cap. 4. of the Treatise on the Heart and Aneurisms of the other. But Sabatier tells us, that, in consequence of this instruction, he examined both these works, without finding any thing on the subject. However this may be, we are informed by the latter, that he noticed the good effects of the practice in an officer, who had an alarming aneurism in front of the humeral extremity of the clavicle, in consequence of a sword-wound in the axilla. The patient, after having been bled several times, was confined to his bed, and kept to an extremely low diet. He was allowed, as drink, only a very acid kind of lemonade. He took pills containing alum, and the swelling was covered with a bag full of powder of oak bark, which was every now and then well wet with port wine. By perseverance in this treatment, the swelling was reduced to a smallish hard tubercle, having no pulsation, and a perfect cure ensued. (See *Sabatier, Médecine Opératoire,* tom. iii. p. 170—172.)

Guerin recommended the application of ice-water, or pounded ice, to aneurismal swellings; a plan, which he represents as being often of itself sufficient to effect a cure. This topical employment of cold applications may be rationally and conveniently adopted in conjunction with Valsalva's practice.

The most interesting facts, in proof of the efficacy of this mode of treatment, were published, some years ago, by Pelletan. The following extract from a well-written critique on "Pelletan's Clinique Chirurgicale," will serve to convey to the reader some idea of the important information contained in the memoir on internal aneurisms:—"The intent in the treatment is to reduce the patient gradually to as extreme a degree of weakness as is possible, without immediately endangering life. It is done by absolute rest, a rigorous diet, and bleeding; to these means, M. Pelletan adds the external application of ice, or cold and astringent washes, &c. He has here detailed many cases from his own practice, of partial, or complete success, which cannot be too generally known, as they may be the means of creating in some, and of confirming in others, a good opinion of the only method of treatment, which has been found at all efficacious in a dreadful, and not an unfrequent, organic disease.

"Of the cases here recorded, some appear to have been cured; in others, the treatment had marked good effects. In extreme cases, at best, it afforded but partial and temporary relief. In one case, that of a robust man, an aneurism at the root of the aorta, with a pulsating tumour of the size of an egg, projecting between the ribs (the edges of which were already partly absorbed), was reduced, so as to recede within the ribs in the course of eight days. At the end of this time, the patient refused to submit any longer. The tumour did not appear again for nearly a year, although he returned to very drunken and irregular habits. He died in about two years and a half, with the tumour again appearing, and much increased in volume. The aneurismal sac communicated with the aorta, by a smooth and round opening, opposite to one of the sigmoid valves. There can be no doubt of the efficacy of the treatment in this case; and it is highly probable, that his health and his life might have been long preserved, but for his own indiscretion. In a case somewhat similar, but not so far advanced, the patient appears to have been cured. There was a swelling on the right side of the breast, about six inches in circumference, with a very strong beating. The pulsation was accompanied with a pain, which stretched towards the scapula and the occiput. It was evident that the disease was an aneurism of the great arch of the aorta. The patient was a crier, of a strong frame, who was accustomed to drink freely. In the four first days, he was bled eight times, drawing three basins, 'palettes,' in the morning, and two in the evening. On the fifth, the pains and the beating were much lessened, but the pulse was still full. He was again bled once. The pulse was in a favourable state, as to strength, till the seventh day, when it again rose, and the man was twice bled.

"During this time, the man was kept to a most rigorous diet. A cold poultice of linseed and vinegar was placed on the tumour, and renewed when it became warm. At the end of eight days, the good effects of this plan were very evident; the pain and the pulsation were gone. The patient, though weak, was in health, and tranquil. He was now allowed more food by degrees. At the end of four weeks from the commencement of the treatment, he left the Hôtel Dieu well. He afterwards led a sober life, and became fatter, without any vestige of disease, except a slight and deep pulsation at the part, in which the aorta may always be felt beating in its natural state. He died two or three years afterwards, of another complaint. His death was not known, and the body was not examined." (See *London Med. Review*, vol. v. p. 123.)

Pelletan also cured by similar treatment a large axillary aneurism, which was deemed beyond the reach of operative surgery. On the thirteenth day, the patient was reduced to a degree of weakness which alarmed many of the observers. From that time, all pulsation in the tumour ceased. The contents were gradually absorbed; and the patient returned to his former laborious life with his arm as strong as ever. The pulse at the wrist was lost in consequence of the obliteration of the axillary artery, and the limb only receiving blood through the branches of the subclavian artery. "*Il y a beaucoup d'exemples d'aneurismes guéris spontanement et sans le secours de l'art* (says Pelletan); *mais on ne peut leur comparer le cas que nous venons de décrire : l'état extrême de la maladie, l'energie des moyens employés, et l'effet immédiat et successif qui en est résulté prouvent assez que le succès a été dû tout entier à l'art.*" (*Clinique Chir.* tom. i. p. 80.)

In this work, we find not less than three cases, in which aneurism of the aorta is stated to have been effectually cured. One instance was greatly relieved; but the disease returned the next year in consequence of the patient's intemperate mode of life. In another example, an aneurism at the origin of the aorta was cured; but the disease recurred in another part of that vessel further from the heart. Even such cases as proved incurable, to the number of fourteen, all received various degrees of palliation from the treatment adopted.

In a modern work of great merit, several other instances are adduced, in which the utility and efficacy of a debilitating plan of treatment are illustrated. (See *Hodgson on the Diseases of Arteries*, p. 146, 147, &c. &c.) In the same publication, as I have previously explained, are various interesting facts, which tend to prove, that when aneurism of the aorta is lessened or cured, this great vessel itself may remain pervious. The progress of the disease is stopped by the blood coagulating in the sac, and closing the communication between the cavity of the aneurism, and that of the artery.

The diet should consist principally of fluids, and it should be gradually reduced. Pelletan sometimes allowed only two basins of broth in twenty-four hours, and lemonade as a common drink. Valsalva, by degrees, increased the food to half a pound of pudding in the morning, and a quarter of a pound in the evening, with a limited quantity of water. By gradual reduction, the solid food may be brought down to four ounces, and fluids to eight. Both the body and mind should be kept in the most perfect quietude; and if the plan is to be strictly enforced, the recumbent position must be constantly maintained. The frequent administration of purgatives, which weaken the action of the heart, is another part of this system of treatment.

It must be confessed, in regard to Valsalva's mode of treatment, that some experienced men do not place confidence in it. Boyer declares himself against it, as not being really efficacious; and he states, that some time ago, it was tried twice in the Hôtel Dieu of Paris. The first trial was made on a patient with an axillary aneurism, which could not be operated upon, on account of its situation; the second on a woman, who had an aneurism of the abdominal aorta. In both cases, the tumour was large, and its parietes reduced to the cellular coat, and the surrounding cellular substance. In these two aneurisms, the progress of the swelling was rapid, and its rupture happened precisely at the moment when the treatment had been pushed to the utmost, and there ought to have been the greatest hope. (*Traité des Maladies Chir.* t. ii. p. 121.)

Sir Astley Cooper declares, that he has seen but little benefit result from this treatment of the disease. According to his experience, only two measures are useful; viz. venesection when the pulse is hard and full; and the administration of the carbonate of soda in considerable doses, which, with entire rest, seem to prevent the increase of the swelling. But, he adds, that the soda is at length unavoidably given up, on account of its producing petechiæ. Sir Astley believes, that the irritability and quickened pulse, produced by antiphlogistic treatment, often do as much injury as the natural force of the circulation. (*Lectures, &c.* vol. ii. p. 48.)

Small occasional bleedings are safer than large ones. In an aneurism of the aorta, especially when combined with organic disease of the heart, bleeding should never be carried to syncope, as, in such cases, this is apt to be alarmingly protracted, and sometimes to terminate fatally. (*Sir Astley Cooper, Dr. Hope,* &c.) The blood should, therefore, be drawn slowly, and in the recumbent posture. Nor should venesection be performed during a paroxysm of palpitation, as the exhaustion consequent on it, superadded to that occasioned by the loss of blood, might depress the patient beyond the possibility of restoration. (See *Hope*, in *Cyclop. of Pract. Med.* art. *Aorta.*)

M. Roux expresses his entire disbelief in the possibility of an aneurism of the aorta being ever completely cured by Valsalva's mode of treatment, because he imagines, that such change could not happen without the tube of that great vessel becoming impervious, and of the lower parts of the body then perishing from stoppage of the circulation. But he bears witness to the utility of such treatment, and recites a case which he attended himself, where an aneurism made a considerable projection on the left side of the sternum, where the cartilages of the third and fourth ribs were raised, the throbbings very forcible, and the sense of suffocation such, that the patient was obliged to keep himself constantly quiet; yet, says M. Roux, though the disease now exists, it forms no prominence on the chest; the pulsations can only be obscurely felt between the ribs; the respiration is but slightly oppressed; and the patient is capable of attending to his business. (*Nouveaux Elém. de Méd. Opér.* t. i. p. 510. 8vo. Paris, 1813.) If any one doubt the possibility of retarding the progress of an aortic aneurism by bleeding, I would refer him to a case, which was laid by me before the profession not long ago. The aneurism burst by a small ulcerated opening into the œsophagus; and after the loss of a vast quantity of blood, not only did the hemorrhage cease for a considerable time, but the external swelling subsided, and the base of the scapula, which had been pushed forwards and backwards by it, returned into its natural position again. (See *Méd. Chir. Trans.* vol. xvi. p. 320.)

Aneurismal Varix; Varicose, or Venous Aneurism; Aneurism by Transfusion.

By these terms, surgeons mean a tumour, arising from a preternatural communication, formed between a large vein and a subjacent artery. Thus, in venesection, performed immediately over the artery, at the bend of the elbow, if the lancet be carried too deeply, it may transfix the vein, and wound the artery; in which event, the arterial blood, in consequence of the proximity of the two vessels, instead of being effused in the cellular substance, will pass directly into the cavity of the vein, which will become dilated in the form of a varix by the jet of arterial blood into it.

Although Sennertus probably referred to an instance of this disease (*Op.* t. v. l. v. cap. 43.), Dr. W. Hunter is undoubtedly the first who gave an accurate description of it. Scarpa is disposed to claim a share of the merit for his countryman Guattani; but, as Mr. Hodgson has remarked, Dr. Hunter's observations on this disease were published in the years 1757 and 1764; whereas, Guattani did not see his first patient until the year 1769, and his book was not published until the year 1772.

"Does it ever happen in surgery," says Dr. Hunter, "that when an artery is opened through a vein, a communication, or anastomosis, is afterwards kept up between these two vessels? It is easy to conceive this case; and it is not long since I was consulted about one, that had all the symptoms that might be expected, supposing such a thing to have actually happened, and such symptoms as otherwise must be allowed to be very unaccountable. It arose from bleeding; and was of some years' standing when I saw it, about two years ago, and I understand very little alteration has happened to it since that time. The veins, at the bending of the arm, and especially the basalic, which was the vein that had been opened, were there prodigiously enlarged, and came gradually to their natural size, at about two inches above, and as much below the elbow. When emptied by pressure, they filled again almost instantaneously; and this happened even when a ligature was applied tight round the forearm, immediately below the affected part. Both when the ligature was made tight, and when it was removed, they shrunk, and remained of a small size, while the finger was kept tight upon the artery, at the part where the vein had been opened in bleeding. There was a general swelling in the place, and in the direction of the artery, which seemed larger, and beat stronger, than what is natural; and there was a tremulous jarring motion in the vein, which was strongest at the part which had been punctured, and became insensible at some distance, both upwards and downwards." (*Med. Obs. and Inq.* vol. i.)

In the second vol. of the same work, Dr. Hunter adds some further remarks: — "In the operation of bleeding, the lancet is plunged into the artery through both sides of the vein; and there will be three wounds made in these vessels, viz. two in the vein and one in the artery, and these will be nearly opposite to one another, and to the wound in the skin. This is what all surgeons know has often happened in bleeding, and the injury done the artery is commonly known by the jerking impetuosity of the stream whilst it flows from the vein, and by the difficulty of stopping it when a sufficient quantity is drawn.

"In the next place, we must suppose, that the wound of the skin, and of the adjacent or upper side of the vein heal up as usual; but, that the wound of the artery, and of the adjacent, or under side of the vein, remain open (as the wound of the artery does in the spurious aneurism), and, by that means, the blood is thrown from the trunk of the artery directly into the trunk of the vein. Extraordinary as this supposition may appear, in reality it differs from the common spurious aneurisms in one circumstance only; viz. the wound remaining open in the side of the vein, as well as in the side of the artery. But this one circumstance will occasion a great deal of difference in the symptoms, in the tendency of the complaint, and in the proper method of treating it: upon which account, the knowledge of such a case will be of importance in surgery. It will differ in its symptoms from the common spurious aneurism, principally thus: — The vein will be dilated, or become varicose, and it will have a pulsating jarring motion, on account of the stream from the artery. It will make a hissing noise, which will be found to correspond with the pulse for the same reason. The blood of the tumour will be altogether, or almost entirely fluid, because kept in constant motion. The artery, I apprehend, will become larger in the arm, and smaller at the wrist, than it was in the natural state; which will be found out by comparing the size and the pulse of the artery, in both arms, at these different places, the reason of which I will speak of hereafter; and the effects of ligatures, and of pressure upon the vessels above the elbow and below it, will be what every person may readily conceive, who understands any thing of the nature of arteries and veins in the living body.

"The natural tendency of such a complaint will be very different from that of the spurious aneurism. The one is growing worse every hour, because of the resistance to the arterial blood, and, if not remedied by surgery, must at last burst. The other, in a short time, comes to a nearly permanent state; and, if not disturbed, produces no mischief, because there is no considerable resistance to the blood that is forced out of the artery.

"The proper treatment must, therefore, be very different in these two cases; the spurious aneurism requiring chirurgical assistance, as much, perhaps, as any disease whatever; whereas, in the other case, I presume it will be best to do nothing.

"If such cases do happen, they will no doubt be found to differ among themselves, in many little circumstances, and particularly in the shape, &c. of the tumefied parts. Thus the dilatation of the veins may be in one only, or in several, and may extend lower or higher in one case than in another, &c., according to the manner of branching, and to the state of the valves in different arms. And the dilatation of the veins may also vary, on account of the size of the artery that is wounded, and of the size of the orifice in the artery and in the vein.

"Another difference in such cases will arise from the different manner in which the orifice of the artery may be united, or continued with the orifice of the vein. In one case, the trunk of the vein may keep close to the trunk of the artery, and the very thin stratum of cellular membrane between them may, by means of a little inflammation and coagulation of the blood among its filaments, as it were solder the two orifices of these vessels together, so that there shall be nothing like a canal going from one to the other; and then the whole tumefaction will be more regular, and more evidently a dilatation of the veins only. In other instances, the blood that rushes from the wounded artery, meeting with some difficulty of admission and passage through the vein, may dilate the cellular membrane between the artery and vein into a bag, as in a common spurious aneurism, and so make a sort of canal between these two vessels. The trunk of the vein will then be removed to some distance from the trunk of the artery, and the bag will be situated chiefly upon the underside of the vein. The bag may take on an irregular form, from the cellular membrane being more loose and yielding at one place than at another, and from being unequally bound down by the fascia of the biceps muscle. And if the bag be very large, especially if it be of an irregular figure, no doubt coagulations of blood may be formed, as in the common spurious aneurism."

A concurrence of two circumstances is requisite for the production of an aneurismal varix: 1. the puncture in the vein, and that in the artery, must be exactly in the same direction; 2. the solution of continuity in the integuments and upper side of the vein must heal, while the wound in the deeper side of that vessel, and the puncture in the upper surface of the artery, remain open, and communicate so readily, that the arterial blood finds greater facility in entering from the artery into the vein, than in being effused from the artery into the surrounding cellular substance.

If one of these two circumstances be wanting, either because the wounding instrument has entered the artery a little obliquely from the vein, or because the vein has not been sufficiently near to the artery, on account of the cellular substance between them, the arterial blood most frequently does not produce the aneurismal varix; or, if it does, the disease is always complicated with effusion of arterial blood into the cellular substance, or with an aneurism and aneurismal varix at the same time. In this case, the small aneurismal sac serves as a short canal of communication between the artery and the vein (*Med. Facts and Obs.* vol. iv. p. 115.); two distinct diseases, in fact, being formed from the same cause, and placed one over the other, viz. an aneurism, and an aneurismal varix. (*Scarpa*, p. 421. ed. 2.) The following marks of distinction between aneurism and aneurismal varix, are pointed out by the same author: the aneurismal varix always forms a circumscribed tumour; aneurism does not always do so. The cellular substance, which constitutes the sac of the aneurism, does not always resist so strongly the impetus of the arterial blood, as the coats of the vein do. Not unfrequently, therefore, aneurism, from being *circumscribed* at first, becomes *diffused;* extends along the course of the wounded artery; compresses strongly the surrounding parts; occasions acute pain and inflammation; and the parts are threatened with gangrene. On the contrary, the aneurism varix is always *circumscribed*, increases very slowly, does not produce much pain, and, as it augments, it always extends, more or less, above or below the place where venesection has been done; and this extension is in proportion to the greater or less force with which the arterial blood is thrown from the artery into the vein, and the greater or less resistance made by the valves situated in the vein below the puncture; and according to the greater or less number of veins communicating with the aneurismal varix. The seat of the disease is generally the basilic or median vein, which appears dilated in an unusual manner, forming an oblong tumour, of the size of a walnut, if the disease is recent. In the centre of the swelling is the cicatrix left by the lancet. The vein is less dilated, the further it is from this scar; and, in general, at the distance of two inches and a half above and below this point, the vessel resumes its natural size. The small tumour, as has been explained, pulsates like an artery, with a tremulous motion and hissing noise, which is sometimes so great that the patient cannot sleep, if he is lying with his head low, and resting on the injured arm. The trunk of the brachial artery, from the axilla down to the place where it has been wounded with the lancet, vibrates with extraordinary force. There is no change of colour, nor inflammation of the skin; and the pain is inconsiderable. The swelling is compressible and yielding; but it returns as soon as the pressure is removed from it. When the arm is kept for some time raised up towards the head, the tumour diminishes; and the same thing happens when pressure is made on the communication between the artery and vein, or when a tight tourniquet is applied near the axilla. If the disease be complicated with aneurism, a second pulsating tumour will be found lying under the aneurismal varix. (*Scarpa*, p. 424. ed. 2.)

A simple aneurismal varix is gradual in its formation, never attaining a considerable size, and never exposing the patient's life to danger by the rapidity of its increase, or a tendency to burst; but, if it be a less serious disease in these respects than a consecutive false aneurism, it does not, like the latter, present any chance of a spontaneous cure, and its duration is perpetual. However, after it has acquired some size, and the veins have become exceedingly varicous, the patient complains of numbness and weakness of the limb, diminution of its temperature; and there is a bluish, or somewhat purple, discolouration of it, which Breschet ascribes to the passage of some of the venous blood into the artery, and to there being a smaller quantity of scarlet blood conveyed by the artery into all parts beyond the tumour. (*Mém. Chir. sur Différentes Espèces d'Aneur.* p. 102.)

It is generally believed that only the blood of the artery leaves its proper vessel; but, according to the investigations of M. Breschet, at the same time that arterial blood passes into the veins, the artery itself receives a certain quantity of venous blood. The symptoms, he observes, demonstrate this during life, as well as the examination of the parts after an operation on the tumour: it is also proved by the appearances of the vessels in *post mortem* examinations. (*Breschet, Mém. sur Différentes Espèces d'Aneurysmes*, p. 100.)

After relating two cases, illustrative of the nature of aneurismal varix, Dr. W. Hunter proceeds to inquire, "Why is the pulse at the wrist so much weaker in the diseased arm than in the other?— surely the reason is obvious and clear. If the blood can easily escape from the trunk of the artery directly into the trunk of the vein, it is natural to think that it will be driven along the extreme branches with less force, and in less quantity.

"Whence is it that the artery is enlarged all the way down the arm? I am of opinion, that it is the consequence of the blood passing so readily from the artery into the vein, and is such an extension as happens to all arteries, in growing bodies, and to the arteries of particular parts when the parts themselves increase in their bulk, and at the same time retain a vascular structure." (See *Med. Obs. and Inq.* vol. ii.) This explanation is not deemed by Breschet altogether correct. M. Breschet has endeavoured to give a more particular and precise explanation of the changes which the vessels and adjacent textures undergo, and the effects of the communication between the arteries and veins. In consequence of the artery receiving venous blood, the flow of this fluid through it becomes slower, and the pulse weaker. The artery itself dilates throughout its whole extent, a fact long ago noticed by Morand; its tunics grow thinner, and become nearly as soft and flaccid as those of a vein. The artery becomes likewise tortuous, and gradually assumes the characters, first, of a vein, and then of a dilated vein. All this happens, however, only below the communication between the two vessels, (*Breschet, Mém Chir. sur Différentes Espèces d'Aneur.* p. 103.) If it were not for the passage of some of the blood of the vein into the artery, Breschet conceives, that it would be impossible to account for the diminished rate of the circulation in the latter vessel, the reduction of sensibility and temperature of the limb, and especially the enlargement of the artery beyond the tumour, its assuming the characters of a vein, and the deeper colour of the blood in it. The vein, likewise, becomes altered around the wound, (below, and particularly above it,) its coats assuming greater solidity and firmness; and, though the vessel is enlarged, the suppleness of its parietes is diminished. (See *Breschet, Op.* cit. p. 104.)

No doubt M. Breschet has extended his criticisms of Dr. Wm. Hunter's account too far, inasmuch as the atrophy and loss of temperature in the extreme part of the limb are certainly, in some measure, owing to a part of the arterial blood flowing directly and prematurely into the venous system. Dr. Wm. Hunter has chiefly erred in overlooking the effect of the entrance of venous blood into the artery. If, as Hunter states, a greater quantity of blood arrives by the artery above the wound, how does it happen, inquires M. Breschet, that the artery should diminish in diameter below the puncture, as Dr. Wm. Hunter affirms that he had ascertained to be the case at the wrist? "For (observes M. Breschet), by the more considerable afflux of red blood, the lower continuation of the artery must be indemnified for the quantity of this fluid which passes into the vein. *A new channel, opened for the arterial blood, cannot* (says he) *bring on a dilatation of the vascular trunk above the aperture of the new channel.* This effect would be more likely to arise from some impediment to the circulation, and is actually what does happen in old consecutive false aneurisms." (See *Mém. sur les Différentes Espèces d'Aneur.* p. 105.) M. Breschet, further on, expresses a suspicion, that Dr. Wm. Hunter perhaps confounded the weakness and softness of the pulse at the wrist with a diminution of the artery. I am of opinion that little foundation exists for this suspicion, because it is certain, that, in some cases of aneurismal varix, the arteries below it, so far from being enlarged, are diminished; and therefore correspond to Dr. Wm. Hunter's description. In proof of this fact, I may refer M. Breschet to the evidence of his distinguished countryman, M. Jules Cloquet, who has given the particulars of the dissection of an aneurismal varix illustrated by a diagram (pl. 1. fig. 13.), where the brachial artery below the tumour was not larger than the middle portion of the radial artery. See *Jules Cloquet, Pathol. Chir.* p. 85. 4to. Paris, 1831.) According to M. Breschet, in old varicous aneurisms of the limbs, and especially of the lower extremities, the principal artery, as well as its branches, are manifestly dilated, and their coats resemble those of veins. "If the same quantity of red blood passed through a vessel of this description, its pulsations would not have the same character as those of the artery of the opposite limb. We think, then, that this change in the pulsations of the artery in old aneurisms, depends both upon the dilatation of the vessel, demonstrated in the dead subject, and upon the passage of venous blood into the artery; for how could dilatation and alteration of the parietes of the vessel be accounted for in any other way?"

In the foregoing passage, the statement that a new channel for the blood, arising from an arterial trunk, will not be followed by an enlargement of that trunk above such channel, seems to me incorrect; for if there be a new channel, blood will be required for it: an increased quantity will therefore pass through the trunk above the new channel, and such trunk of course increase in size, agreeably to a well-established law of the animal economy. The case of an old false aneurism, referred to by M. Breschet, seems to me rather to invalidate, than strengthen, his conclusion, respecting the cause of the enlargement of the arterial trunk above the disease. This change is not ascribable to impediment of the circulation, but to the blood having new channels to supply: viz. the sac, and the enlarged collateral anastomosing vessels.

An interesting circumstance, pointed out by M. Breschet, is, that the dilatation of the artery beyond the injury, is not exemplified in all varicous aneurisms. Their situation has considerable influence in producing it; for it can only take place in vascular trunks of large calibre; and it is requisite, also, that venous blood pass into the artery, and that the circulation of this fluid be favoured by the laws of hydraulics and the power of gravitation. Hence, this dilatation of the injured artery, regarded by M. Brischet as the consequence of the admission of a certain quantity of venous blood into it, is principally noticed in varicous aneurisms of the limbs, and not in those of the neck, or subclavian region. The wound in the artery must likewise have a certain extent, be constantly gaping, and in direct communication with the vein. (See *Breschet*, in *Mém. sur Différentes Espèces d'Aneur.* p. 107.) In the remarkable case of spontaneous varicous aneurism of the thigh, recorded by Mr. Perry, the posterior tibial artery, and the other arteries in the neighbourhood of the aneurism, were apparently sound, (See *Lond. Med. Gaz.*, Nov. 1835.)

In thin subjects, the median basilic vein is so close to the brachial artery, the track of which it crosses at a very acute angle, that it is almost impossible to open it at this point, without risk of wounding the artery at the same time. Although the bend of the arm is the situation, in which the aneurismal varix and venous aneurism are usually noticed, it is easy to conceive, that they may happen wherever an artery of a certain diameter lies immediately under a large vein. Thus, Lassus saw an aneurismal varix in the ham, the consequence of a wound with a sword, which had transfixed the popliteal vein and artery. (*Méd. Opér.* t. ii. p. 442.) Breschet records instances of it at the upper and inner part of the arm; in the thigh; and in the neck, from a communication formed between the common carotid and the internal jugular vein, by a wound. He likewise gives the particulars of several occasioned by venesection at the bend of the arm, the ordinary situation of the disease. Larrey records examples of it in the subclavian vessels, the external iliac, the popliteal, and between the carotid artery and internal jugular vein. (*Mém. de Chir. Clin.* t. iii.)

The frequency with which Dupuytren met with these arterioso-venous aneurisms, as he terms them, was considerable; for, during fifteen years, not a single year passed without his being consulted for at least two cases. For the prevention of them, he recommends the following rules: — 1. That venesection should never be practised, until the pulsation of the artery is felt. 2. That the vein immediately over the artery should never be punctured. 3. That some other vein should be selected. He admits, however, that other veins sometimes cannot be readily found, and that they do not always yield the requisite quantity of blood; still he deems these inconveniences slight, in comparison with that of exposing the patient to a wound of the artery. (*Dupuytren, Clinique Chir.* t. i. p. 262.) While I fully coincide with this eminent surgeon, in recommending a vein to be generally preferred, which does not lie directly over the artery, I do not agree with him, that the practitioner should not open the median basilic vein, if another could not be easily found, which would furnish the proper quantity of blood. I frequently bleed in the median basilic vein; and as there is the fascia between it and the artery, believe, that the latter vessel can only be wounded by a very careless or unskilful hand. Indeed, when Dupuytren, in censuring the custom of letting perfect novices in the profession attempt venesection (p. 261.), he is adverting to the chief cause of the accident. The last case which I saw, was in a woman who had been bled by a farrier.

Baron Larrey, surgeon to the hospital at Toulouse, saw a case of aneurismal varix, which had been occasioned by a wound of the popliteal vein and artery; and a history of the disease, accompanied with the pathological preparation, was sent to the former Royal Academy of Surgery at Paris. "The varicous swelling, which was as large as two fists, occupied the whole of the ham in a middle-aged man, who some years previously had been wounded with a sword in that part of the limb. At a consultation, amputation was deemed necessary, and was performed with success. At the bottom of the varicous pouch, the communication between the popliteal vein and artery was observed. The sac itself was evidently composed of the vein, the parts of which, adjacent to the varicous swelling, were dilated, especially the lower continuation of the vessel. The popliteal nerve was rendered flat, like a piece of tape, and adherent to the outside of the cyst." (See *Mém. de Chir. Mil.* t. iv. p. 340.; *Boyer, Traité des Mal. Chir. &c.* t. ii. p. 177.) — Two cases are likewise recorded by Mr. Hodgson. In one, the disease was caused in the thigh, about four inches below Poupart's ligament, by the point of a heated iron rod, which had passed through the femoral artery and vein. In the other example, the aneurismal varix was situated in the ham, and was the consequence of a wound in that part with a pistol-ball. (*On the Diseases of Arteries*, p. 498.) Larrey records one example of aneurismal varix, situated under the clavicle.

P. Cadrieux was wounded with a sabre in a duel, on the 20th of November, 1811: part of the attachment of the sterno-mastoid muscle was divided, the anterior scalenus, the subclavian artery and vein at a very deep point, and probably also a portion of the brachial plexus. A most violent hemorrhage took place, followed by syncope. Pressure was applied to the wound, and the patient conveyed to the hospital at Gros Caillou. The external wound, which was small, did not bleed at all the following morning; but the clavicle was quite concealed by a large tumour, which throbbed with the arteries, particularly at its lower part. A peculiar noise, like that of the passage of a fluid through tortuous metallic tubes, could also be felt more deeply, in the direction of the axillary vein. The arm was quite cold, insensible, motionless, and without any pulse even in the axillary artery itself. On the 22d, the tumour was not larger, but its throbbings were stronger; the jugular vein on the same side was considerably dilated; and the pulsation of the carotid, and of the arteries of the opposite arm, had augmented. A vein in the right arm was opened, and compresses dipped in camphorated vinegar, muriate of ammonia, and ice, applied to the swelling. It would be superfluous here to detail the diet, bleedings, and other parts of the treatment. On the 8th day, the outer wound was quite healed. On the tenth, the veins of the limb were observed to be swelled, and sensibility and warmth were returning in it; though no pulse could yet be felt. The tumour was much smaller, and restricted to a circumscribed place behind the great pectoral muscle; but the hissing sound was still plainer. By degrees, the muscles of the arm and forearm regained their power of motion. The hand, however, continued useless, and affected with pricking pains. On the 20th day, the tumour was quite gone; but the hissing sound was unaltered, and the throbbings were still evident in the veins of the neck and arm. The arm was not at all emaciated. On the 55th day, a pulse at the wrist could be slightly felt: the hissing sound had become less distinct; the veins were less turgid, and their throbbing had diminished. A second instance of aneurismal varix, or rather, perhaps, of a varix of all the veins of the arm, caused by a sword-wound of the axilla, is recorded by Larrey. In the most prominent of the large vessels, there was a pulsation. (*Mém. de Chir. Mil.* t. iv. p. 341, &c.)

Dr. Dorsey, of Philadelphia, published a case of aneurismal varix, which is in several respects interesting. A patient was wounded in the leg with buck-shot; and after the cure of the injury, an aneurismal varix was noticed just below the knee; and, in a little time, the superficial veins of the limb became dilated, and the hissing noise, characterizing this species of aneurism, could be plainly distinguished. The patient was seen by Dr. Dorsey, twelve years after the accident; the veins were then considerably distended from the toes up to the groin, all about which latter part pain was constantly experienced, and some ulcers situated on the foot and ankle could not be healed by any of the remedies which were tried. The patient was under the care of Drs. Physick and Wistar. The enormous distention of the vessels of the leg, and the uncertainty of finding out the communication between the artery and vein, led these gentlemen to tie the first of these vessels in the middle of the thigh. Gangrene soon ensued, and in this state the patient was further weakened by an unexpected hemorrhage from one of the distended veins; and though the vessel was secured with a ligature, the bleeding recurred, the patient became more and more enfeebled, and at length expired. When the limb was examined after death, the whole of the trunk of the femoral artery was found preternaturally dilated, while all the veins of the limb were considerably distended; a bougie could readily be passed from the popliteal into the posterior tibial artery which participated in the dilatation, and from this last artery, the instrument could be passed into the vein, through a cyst, situated on the inside of the leg below the knee. (See *Dorsey's Elements of Surgery*, vol. ii. p. 210. Philadelphia, 1813.)

In November, 1835, Mr. Perry, surgeon to the Marylebone Infirmary, communicated to the Royal Medical and Chirurgical Society of London, the history of a remarkable case of varicous aneurism. It was a case in which death ensued six days after an operation for aneurism of the femoral artery, in consequence of the sac having communicated with the accompanying vein. I believe this patient was shown to me some months before the operation, when, from the peculiar thrilling sensation and hissings then perceptible, I intimated my expectation, that a communication existed between the femoral vein and the artery. This is not the only instance on record, where a similar condition was spontaneously established between a great vein and a neighbouring artery; for Mr. Syme, of Edinburgh, has published the particulars of a case, in which a free communication was found between the descending vena cava and the aorta, close to their bifurcations, attended with a considerable swelling of the latter vessel. (See *Edin. Med. and Surgical Journ.* No. 108.)

Professor Scarpa, Dr. Hunter, B. Bell, Pott, and Guattani, mention cases of aneurismal varix, which remained stationary for fourteen, twenty, and thirty-five years. Several cases are related by Brambilla, Guattani, and Monteggia, of a cure having been obtained by means of compression. But, as this method of cure, if it does not succeed, exposes the patient to the danger of a complication of the disease with an aneurism, it ought not to be employed, except in recent cases, where the tumour is small, and in slender patients. Sir Astley Cooper mentions in his Lectures, that he once cured the aneurismal varix in a young lady, by compression with an instrument; and, in the Museum of the London University is a preparation, given to that institution by Mr. Oldknow, illustrating the power of pressure to effect a cure, even when the disease consists of a varix and a false aneurism together. In this preparation, the communication between the vein and the subjacent aneurism, and that between the aneurism and the artery, are obliterated; while the remains of a small sac are discernible between the artery and vein. The case was treated by Mr. Oldknow. I have seen one example cured by compression; the case was recent, and in a woman about forty, who had imprudently suffered herself to be bled by a farrier.

Two cases are recorded, in which it was necessary to operate in consequence of the disease being joined with aneurism of the artery, and even bursting. The sacs were opened, and a ligature applied both above and below the aperture in the artery. (See *Park*, in *Medical Facts and Obs.* vol. iv. p. 111.; and *Physick*, in *Medical Museum*, vol. i. p. 65.) The latter form of the disease, which is particularly noticed by Dr. Hunter, and also by my friend Mr. Hodgson, is readily understood by recollecting, that the artery and vein, when punctured together, do not always unite in such a manner as to let the arterial blood have a direct passage into the vein; but they may be separated for some distance from each other, so that the blood passes from the artery into the adjacent cellular membrane, where a sac is formed, into which the blood is poured previously to its entrance into the vein. (See *Gibson's Institutes of Surgery*, vol. ii. p. 158. Philadelphia, 1825.)

In the winter of 1819, I heard a case read to the Medical and Chirurgical Society of London, from Mr. Atkinson of York, who had found it necessary to take up the brachial artery, on account of the large and increasing size of an aneurismal varix; mortification of the limb ensued. In the Museum of the London University is a preparation, taken from a person on whom Sir Charles Bell operated for a venous aneurism, and who died of gangrene of the limb. In this case, there was a high bifurcation of the brachial artery, and the radial division had been punctured in bleeding. The preparation exhibits a double aneurism; one being under the fascia, and communicating with the dilated portion of the vein through an opening in that texture. An anastomosing branch, between the radial and ulnar, is seen equal in size to either of them. I believe that the records of surgery prove, that operations for the cure of venous aneurisms have more frequently been followed by mortification, than operations for other aneurisms; and when it is considered, that the extreme part of the limb, even previously to the ligature of the artery, is deprived of a great quantity of the arterial blood, which ought to be distributed to it, that venous blood gets into the artery, and that it has a difficulty in maintaining its proper temperature, the fact seems accounted for. These considerations, joined with the recollection that the disease, after attaining a certain size, generally remains stationary through life, ought to make surgeons decline an operation, except when the increase of the false aneurism, or an unusual degree of annoyance from the swelling, justifies the opposite line of conduct. Here the artery, then, has a ligature applied to it under very disadvantageous circumstances. When an arterial trunk is tied, soon after the wound of an artery, as M. Breschet observes, hopes may be entertained of the member preserving its vitality, because its several textures are in a favourable state for receiving blood from the vessels of small calibre. The anastomoses between the trunk of the vessel; above and below the ligature, possess the advantage of having the lower portion of the artery sound, and fitted for carrying on the circulation. But, when a ligature is applied to an artery for venous aneurism of long standing, the part of the artery, situated below the disease, is dilated; its coats are weakened; they no longer possess the contractility requisite to carry on the circulation; and the vitality of the tissues being thus reduced, the fluids stagnate in them, and the parts are soon seized with gangrene or paralysis. (See *Mém. Chir. sur Différentes Espèces Aneurysmes*, p. 109.) If the limb be not seriously affected with atrophy, and a diminution of its temperature, sensibility, and power of action, the wisest plan is to let the disease alone, or, at most, only to make gentle equable pressure on the limb, and on the point corresponding to the wound of the artery. In the opposite circumstances, says M. Brechet, a surgical operation is indicated, which should not consist in the simple ligature of the artery between the heart and the wound, because the return of the blood through the lower portion of the artery would reproduce the disease, especially if the wound were not recent. Neither, says he, should it consist in merely tying the artery beyond the injury, or in the separate ligature of the vein above it, because these proceedings would expose the patient to the risk of various inflammatory accidents, or to a false aneurism, either circumscribed or diffused. But, it is better and safer to place the injury of the vessels between two ligatures. By acting in this manner, not only do we hinder the blood from returning through the lower end of the artery, and reproducing the disease, but we prevent the venous blood from passing into the artery, and thereby avert the stupor which the passage of this black blood into the tissues always creates; a stupor the more considerable, and the more readily followed by gangrene, inasmuch as the red blood enters the organized textures in less quantity, and with increased difficulty. (See *Breschet, in Mém. sur Différentes Espèces d'Aneurysmes*, p. 153.) If the artery be tied both above and below the communication with the vein, the exchange of blood between the two vessels will be effectually stopped: the proposal once made by Dupuytren, to include the vein in the ligatures along with the artery, must therefore be unnecessary, and, as likely to cause phlebitis, it should not be adopted. Indeed, Dupuytren himself never tried the plan on the living subject. (See *Malgaigne, Manuel, &c.* p. 195.) As for the mode of operating, different writers give different advice. Thus, according to Scarpa, when the aneurism is joined with an aneurismal varix, and circumscribed, but the circumstances such as to require the brachial artery to be tied, this vessel should be exposed, and tied above the swelling with a single ligature. It is only when the aneurism is diffused, that opening the swelling and applying a ligature both above and below the aperture in the artery, are deemed by him necessary. On the other hand, Mr. Guthrie directs "an incision at the part, and the application of two ligatures to the artery, for, although in some cases one has been found sufficient, in others, the blood has returned into the sac by the anastomosing branches, and a second operation has been required to effect a cure." (See *Guthrie on Dis. of Arteries*, p. 334.) M. Lisfranc prefers opening the sac, and applying two ligatures. "Perhaps," says he, "in examples where a sac intervenes between the dilatation of the vein and the injury of the artery, it might be prudent to open the aneurismal pouch, without meddling with the vein; a method that would create less risk of phlebitis, which sometimes arises as a complication of the operation." (*Des Oblitération des Artères dans les Aneurysmes*, p. 112. 8vo. Paris, 1834.) In three subjects, in whom the brachial artery was tied, the tumour reappeared (*Dupuytren, Breschet*); and in two others, in whom the femoral artery was tied, death ensued from sloughing and hemorrhages. M. Jules Cloquet relates a case where the ligature of the artery, above the communication with the vein, was followed by a return of the pulsation in the tumour, atrophy of the limb, a livid discoloration of the fingers, and detachment of the nails, and ampution was performed, (*Pathol. Chir.* p. 85. 4to. Paris, 1831.) Hence Dupuytren, Breschet, and Malgaigne are of opinion, that the Hunterian method, with a single ligature above the tumour, should be abandoned. (See *Manuel de Méd. Opér.* p. 195. 12mo. Paris, 1834; *W. Hunter*, in *Med. Obs. and Inq.* vol. v.; *Scarpa on Aneurism*, p. 433. ed. 2.; also *Guattani, De Cubiti flexuræ aneurysmatibus*, in *Lauth's Coll. Scriptorum, &c.*; *P. Adelmann, Tract. Anat. Chir. de Aneurismate spurio varicoso.* Wirceb. 1824; *Dupuytren Répert. Gén. d'Anat. et de Physiologie, &c.* t. viii. p. 104. 1829, and *Clin.* t. i. p. 275, &c.; *Larrey*, in *Mém. de Chir. Mil.* t. iv., and in *Clin. Chir.* t. iii.; *G. Breschet, De l'Aneurysme par Transfusion*, in *Mém. Chir. sur Différentes Espèces d'Aneurysmes*, 4to. Paris, 1834.)

Aneurism by Anastomosis

Is the term which Mr. John Bell applied to a species of aneurism, resembling some of the bloody tumours (*nævi materni*) which appear in newborn children, grow to a large size, and ultimately bursting, emit a considerable quantity of blood. Imperfect descriptions of this disease may be traced in writers; though, before the publication of Mr. John Bell's Principles of Surgery, it was not classed with aneurisms. Thus, Desault has recorded a case of this affection, for the express purpose of proving, that pulsation is an uncertain sign of the existence of an aneurism. (See *Parisian Chir. Journal*, vol. ii. p. 73.)

Aneurism by anastomosis often increases from an appearance like that of a mere speck, or mother's mark, to a formidable disease. The tumour is a congeries of active vessels; and, according to Mr. John Bell, the cellular substance, through which these vessels are expanded, resembles the gills of a turkey-cock, or the substance of the placenta, spleen, or womb. The irritated and incessant action of the arteries fills the cells with blood, and from these cells it is reabsorbed by the veins. The size of the swelling is increased by exercise, drinking, emotions of the mind, and by all causes which accelerate circulation.

Aneurism by anastomosis is compared by Dupuytren to certain erectile tissues, which naturally appertain to the organization of the animal body. In this point, there is an agreement between him and John Bell. "A texture of this kind," says Baron Dupuytren, "is met with in the genital organs of many animals of both sexes, and particularly in the urethra, the corpora cavernosa, and the glans penis; on the heads and necks of many birds; on the buttocks of several species of ape; and on parts of the bodies of many other animals. This erectile tissue was regarded by Dupuytren as the model and type of several accidental tissues, which, in consequence of defects of organization, either original or acquired, may be developed in almost any part of the human body, where they produce tumours, which frequently attain a considerable size. Such growths all exhibit the same vascularity and organization, the same investment, and the same fibrous interlacement, as the natural erectile tissues do; but their investment is weaker, and the quantity of nerves in them is less. The skin and subcutaneous cellular tissue are particularly often the seats of tumours of this character, which, however, are sometimes met with in almost every part. In particular, they present themselves on the face and the integuments of the cranium; and they form those basis of the congenital marks and swellings, which receive the name of nævi. Sometimes they invade the whole of an organ. Thus, Dupuytren had a case, in which the whole of the external ear, and a portion of the contiguous parts, were converted into a true erectile mass. In other examples, the new growth leads to the formation of tumours of various size, placed in the very substance, or in the interstices of organs. Under some circumstances, the accidental erectile tissue seemed to Dupuytren to be the product of a degeneration of some natural texture, and of the dilatation of its capillary network; while, on other occasions, it appeared to him to be in reality a new organ developed amongst the parts. In the first case, it is confounded on every side with the healthy textures; in the second, it separates these textures from one another, compresses them, and at the same time remains divided from them by a dense cellular investment, by which it is circumscribed.

The accidental erectile tissues of Dupuytren, corresponding to the aneurism by anastomosis of John Bell, the tetangiectasiæ of Graefe, the cylindroid aneurism of the small arteries of M. Breschet, and the nævi of many writers, are generally of a reddish or brownish colour, often granular on their surface, and situated in the skin, the subcutaneous cellular tissue, or between the muscles. From the investigations of M. Breschet and Scarpa, it appears that the small vessels of the bones, as well as the soft parts, are occasionally the seat of aneurism by anastomosis. (See *Breschet* in *Répert. d'Anat. &c.* t. i. annèe 1826; *Scarpa, Annali Univ. di Med.* 1830. Tumours of this character are either flaccid or prominent. Sometimes the skin, under which they lie, is scarcely altered. A kind of motion is perceptible in them, synchronous with the arterial pulse. Pressure reduces them to a very small size. Though usually soft, any irritation or excitement renders them remarkably tense and turgid; and if they happen to be wounded, the hemorrhage from them is profuse, and often very difficult to stop. The blood, though of a vermilion colour, and manifestly arterial, does not flow out *per saltum;* but trickles away, just like what happens in cases of fungus hæmatodes. (*Dupuytren, Clin. Chir.* t. iv. p. 8.) Tumours of this description do not spontaneously disappear, but, on the contrary, have a tendency to increase in magnitude. In a few instances, however, they have been known to disperse in consequence of an accidental attack of inflammation; and Professor Gibson, of the United States, gives an instance of this, which occurred during a fever. (*Pract. and Inst. of Surgery.*) Like the natural erectile tissues, these tumours undergo, at the same epochs, and from the same causes, a marked developement, and alternations of tension and relaxation, which are in relation to the healthy or unhealthy state, the strength or weakness, of the individual. (See *Dupuytren, Clinique Chir.* t. iv. p. 3—5.)

I have mentioned the observation of Dupuytren, that the accidental erectile tissue forms the basis of those congenital marks and substances, which go under the name of nævi materni. As Mr. Guthrie remarks, however, "It is only when these spots, or marks, are subcutaneous, that their nature approaches to that of aneurism by anastomosis. The milder kinds of subcutaneous disease, to which the name of nævi is often applied, differ much both in appearance and size; sometimes remaining stationary through life, and, in others, even disappearing altogether, or becoming small solid prominences. A nævus is usually of a red colour, with a bluish cast, shining through the skin, which appears to be exceedingly thin. It has also a tolerably defined and terminating edge; and the disease of the vessels seems to be confined to the part discoloured, or extends to a very short distance around it. The tumour, or nævus, although large and elevated in size, does not pulsate. An aneurism by anastomosis, in its most formidable shape, is a swelling of a more or less elevated form. The skin is in general thickened, and its colour is sometimes but little altered, although it more frequently has a bluish cast, which may even tend to red. The pulsatory nature of the tumour is distinct, and the vessels, both arteries and veins, leading to or from it, are enlarged for some distance. The tortuous forms, which the veins particularly assume, give to this disease a distinct character, which cannot be mistaken." (See *Guthrie, On Dis. of Arteries,* p. 341.; also *Breschet, Mém. Chir.* p. 28.)

Several writers describe an essential difference between simple nævi and aneurism by anastomosis to be this: in the former, the veins are chiefly affected; in the latter, the arteries. To this view Mr. Guthrie inclines, for he says, "When the arteries partake most of the disease, the indistinct throbbing attendant on it is soon perceptible, and becomes in a short time a marked pulsation; but, in cases which more frequently occur in children, and are congenital, and the disease seems more to affect the veins, the swelling will be considerable, the veins greatly dilated, and the part have a varicous appearance, without any pulsatory motion." (See *Guthrie, On Dis. of Arteries,* p. 344.) The *cylindroid aneurism* in the vessels of the smallest diameter, for instance, in the capillaries, says M. Breschet, is named *aneurism by arterial anastomosis,* and *anurism by venous anastomosis.* In the first of these tumours, there are pulsations synchronous with the pulse, and alternate rises and falls corresponding to the diastole and systole of the arteries, circumstances not remarked in aneurisms of the second kind; which, however, in certain states of the circulation, exhibit a sort of erection or turgescence, produced by the influx of a greater quantity of venous blood. (See *Breschet,* in *Mém. Chir. des Différentes Especes d'Aneurysmes.*)

It is observed by Mr. Syme, that most surgeons have followed John Bell in believing aneurism by anastomosis to consist of a morbid cellular structure, through which the blood passes in its course from the arteries into the veins. However, he has long been one of those who maintain, that the apparent cells are really sections of enlarged vessels. (See *Ed. Med. Journ.* No. 98. p. 72.)

In the dissection of a pulsating tumour of the scalp in a patient who had died after the operation of tying the carotid artery, Dr. Maclachlan found the branches of this vessel on the head "degenerated into dilated tubes of extreme thinness and transparency; which, apparently yielding to the impetus of the blood, had become elongated, contorted, and ultimately convoluted on themselves, so as to form, by this species of doubling, the tumours, which constituted this singular disease." They felt like placenta, and the larger portion, immediately over the ear, looked precisely like a bundle of earthworms coiled together. (See *Glasgow Medical Journ.* vol. i. p. 85.) Two cases are given by Pelletan, fully confirming the view, taken of the nature of the disease by Dr. Maclachlan and Mr. Syme. (See *Clinique Chir.* t. ii.) Boyer, who saw one of these cases, describes all the arteries of the swelling as being dilated, tortuous, knotty; and though very large in some places, in others contracted. (*Traité des Mal. Chir.* t. ii. p. 295.) In the tumour described by Dr. Maclachlan, none of the cells, spoken of by Mr. John Bell, were found; no parenchyma, as in the spleen; the bulk of the tumour was formed almost entirely by convoluted dilated arterial *trunks*, the veins being but little changed from their healthy state. He adds, that these arteries did not appear to communicate more freely than by their ordinary inosculations. Some of these conclusions appear to me to require corroboration by a careful anatomical injection of the vessels.

Why, however, should there not be varieties in this disease? The observations of Baron Dupuytren make allusion to modifications of it; and, according to Mr. Guthrie, dissection has shown, that, in some instances, the tumour has been formed by contortions and reflections of the vessels alone; whilst, in others, the spongelike appearance has been more distinct. (*On Dis. of Arteries,* p. 343.) He adds, that in nævi of large size, and marked characters, as well as in aneurism by anastomosis, the disease essentially consists of vessels, with the interposition of very little cellular structure. However this may be, I believe Dupuytren correct in describing aneurism by anastomosis as essentially a new growth, consisting of an adventitious erectile cellular tissue, pervaded by a congeries of blood vessels. Thus, in giving the particulars of a case of aneurism by anastomosis of the ear and side of the head, Dupuytren states, that two very different elements were distinguishable in the mass, both by the finger and the eye. The first presented itself in the form of wide, sinuous, irregular knotty tubes, full and compressible, winding over the temple and ear, to which they communicated a knobby appearance. These tubes arose one from another, in the manner of arteries; and the trunk of them, which was equal in size to the little finger, gradually diminished, still retaining, however, in its smallest branches, the diameter of a crow-quill; and these could be traced even into the skin. The origin, the situation, the direction, and the divisions of these tubes, and especially their pulsations, synchronous with those of the heart, and the force of which seemed to threaten every instant a rupture of the tumour, and a perilous hemorrhage, were a sufficient proof that they were formed by the arterial system of the ear, temple, and occipital region, extraordinarily dilated in its trunk, branches, and cutaneous ramifications. All that did not immediately belong to the dilatation of the arterial trunks, was formed of accidental erectile tissue, which filled up the interstices of the network of vessels, and gave to the parts their purple colour, their higher temperature, and their double movement of expansion and subsidence. The tumour shrivelled and became pale under slight compression; but soon resumed its usual colour, size, and tension. (See *Dupuytren, Clin. Chir.* t. iv. p. 13.)

In the female subject, the hemorrhage from the aneurism by anastomosis is sometimes a substitute for menstruation, as the following example illustrates: — Ann Vachot, of St. Maury, in Bresse, was born with a tumour on her chin, of the size and shape of a small strawberry, without pain, heat, or discolouration of the skin. As it produced no uneasiness, nor inconvenience whatever, it excited little attention, particularly as it did not seem to increase with the growth of the child. For the first fifteen years, there was but little alteration; but, about the menstrual period, it increased suddenly to double the size, and became more elongated in its form. A quantity of red blood was observed to ooze from its extremity. This flux became, in some measure, periodical, and sometimes was sufficiently abundant to produce an alarming degree of weakness. Each period of its return was preceded by a violent pain in the head, and numbness. Before and after the appearance of these symptoms, there was no alteration in the size of the tumour; the only difference was a small enlargement of the cutaneous veins, with an increase of heat in the part, occasioning some degree of tenderness. The menses at length took place, but in small quantity, and at irregular periods, without influencing the blood discharged from the tumour, or the frequency of the evacuation. The breasts were not enlarged till a late period, nor did the approach of puberty seem to have its accustomed influence on those glands, &c. (See *Parisian Chir. Journ.* vol. ii. p. 73, 74.)

In the article Nævus, I shall explain the modes of treatment applicable to the superficial kinds, and at present consider what should be done for the cure or relief of the subcutaneous and deeper forms of the disease, to which the term aneurism by anastomosis more particularly refers.

The first plan, which I shall notice, is that of removing the disease with a knife. This should only be attempted where the morbid tissue does not extend too deeply, and where there is a fair prospect of being able to take every particle of it away, without endangering life by hemorrhage. As Mr. John Bell inculcates, the rule in this operation is, not to cut into the diseased part, but to cut it out (see *Principles of Surgery,* Disc. ix.); a piece of advice repeated by Mr. Wardrop, when he says, the surgeon should avoid cutting into the tumour; for, unless this caution be attended to, the hemorrhage is violent; whereas, by making the incisions beyond the diseased structure, the flow of blood is much more moderate. (*Med. Chir. Trans.* vol. ix. p. 212.) If the incisions be carried into the morbid tissue, the hemorrhage will be great, because the enlarged and diseased vessels have lost their power of contracting, and there will also be a probability of the return of the disease. "If the nævus be large, round, or of a figure which does not admit of its being removed by two elliptical incisions, so as to give a reasonable hope of union, or if the cicatrix is likely to be large and unseemly, the operation by ligature is to be preferred." (See *Guthrie, On Dis. of Arteries,* p. 346.) I find that extirpation with the knife answers remarkably well when the disease is on the lip, or part of the ear, care being taken to cut in the sound part. I have removed many swellings of this kind from the lips of young children, and always found the hemorrhage cease directly the edges of the wound were brought together with the twisted suture.

The following case, recorded by Mr. Wardrop, affords a valuable illustration of the nature and structure of one form of this disease. A child was born with a subcutaneous nævus on the back part of the neck, of the form and size of half an ordinary orange. The tumour had been daily increasing; and when Mr. Wardrop saw it, ten days after birth, the skin had given way, and a profuse hemorrhage had taken place. The swelling was so soft and compressible, that, when squeezed in the hand, it yielded like a sponge, and was reducible to one third of its original size. On removing the pressure, however, the tumour rapidly filled again, and the skin resumed its purple colour. "Conceiving the immediate extirpation of the tumour the only chance of saving the infant (says Mr. Wardrop), I removed it as expeditiously as possible, and made the incision of the integuments beyond the boundary of the tumour; aware of the danger of hemorrhage, where such tumours are cut into. So profuse, however, was the bleeding, that, though the whole mass was easily removed by a few incisions, the child expired.

"The tumour having been injected, by throwing coloured size into a few of the larger vessels, its intimate structure could be accurately examined. Several of the vessels, which, from the thinness of their coats, appeared to be veins, were of a large size, and there was one sufficiently big to admit a full-sized bougie." This vessel was quite as large as the carotid artery of an infant. The boundaries of the tumour appeared distinct, some healthy cellular membrane, traversed by the blood vessels, surrounding it. On tracing these vessels to the diseased mass, they penetrated into a spongy structure, composed of numerous cells and canals, of a variety of forms and sizes, all of which were filled with the injection, and communicated directly with the ramifications of the vessels. These cells and canals had a smooth and polished surface, and in some parts, resembled very much the cavities of the heart, fibres crossing them in various directions, like the chordæ tendineæ. The opening in the skin, through which the blood had escaped during life, communicated directly with one of the large cells, into which the largest vessel also passed. (*Wardrop,* in *Med. Chir. Trans.* vol. ix. p. 203.)

This case furnishes an instructive warning to us not to attempt to cut out an aneurism by anastomosis, where the size of it, and the age or weakness of the individual, render it probable that he will not bear the loss of blood. I lately saw a child with Messrs. Gilchrist, of Sunbury, aged about two years, with a tumour over the base of the scapula, the nature of which seemed obscure. I made an exploratory puncture in it, meaning to remove it at once, if composed of fat. But the profuse gush of blood which followed the lancet, and the pulsations felt in the swelling during the child's agitation, left no doubt about the case being an aneurism by anastomosis. As the tumour was as large as half an orange, and the child so young, I refrained from the attempt to cut it away, fearful that the bleeding might be more profuse than the little patient would bear. Mr. Lawrence, who has since been consulted, does not recommend the operation.

In the Section on Carotid Aneurisms, I have mentioned the cases, in which Mr. Travers and Mr. Dalrymple cured aneurisms by anastomosis in the orbit, by tying the common carotid artery; a practice which has been repeated with success very lately by Mr. Busk, surgeon to the Dreadnought hospital ship at Deptford. (See *Lond. Med. Gaz., Feb.* 27. 1836.) Professor Pattison cured an immense anastomosing aneurism of the cheek and side of the face by taking up the carotid artery. (See *Med. and Phys. Journ.* vol. xlviii. July, 1822.) These facts prove, that aneurism by anastomosis, like many other diseases, sometimes admits of being cured, on the principle of cutting off, or lessening, the supply of blood to the part affected.

However, surgeons must not be too confident of being always able to cure the disease, by tying the main artery, from which the swelling receives its supply of blood; and the great cause of failure is the impossibility of preventing in some situations the transmission of a considerable quantity of blood into the tumour, through the anastomosing vessels. A case is recorded by Maunoir, in which he applied a ligature for three days to the carotid artery, and obliterated it; yet the benefit effected seemed to be only temporary, as, in a short time, the tumour was as large as before. (See *Med. and Phys. Journ.* vol. xlviii.) In fact, every vessel, artery, and vein, around the disease, seems to be enlarged and turgid; and the inosculations are so infinite, that no point of the circumference of the swelling can be imagined which is free from them. Etienne Dumand was born with two small red marks on the antihelix of the right ear. Until the age of twelve years, the chief inconveniences were a sensation of itching about the part, occasional bleeding from it, and the greater size of this than of the other ear. The disease now extended itself over the whole antihelix, and to the helix and concha; and the upper part of the ear became twice as large as natural. Slight alternate dilatations and contractions began to be perceptible in the tumour, which was of a violet colour, and covered by very thin skin. Soon afterwards any accidental motion of the patient's hat was sufficient to excite copious hemorrhages, which were difficult to suppress, and, at the same time that they produced great weakness, caused a temporary diminution of the tumour and its pulsations. At length the disease began to raise up the scalp for the distance of an inch around the meatus auditorius, and the hemorrhages to be more frequent and alarming. Pressure was next applied to the temporal, auricular, and occipital arteries; but, as the patient could not endure it, the first two of these vessels were tied, the only benefit from which was a slight diminution in the pulsation and bulk of the swelling. This treatment did not prevent the return of hemorrhage, and therefore, forty-three days after the first operation, a ligature was applied to the occipital artery. As the disease still continued to make progress, the patient entered the Hôtel Dieu, where, on the 8th of April, 1818, Dupuytren tried what effect tying the trunk of the carotid artery would produce on the swelling. As soon as the ligature had been applied, the throbbings ceased, and the tumour underwent a considerable diminution. On the 18th day, slight expansions and contractions of the diseased part of the ear were again perceptible, though the swelling had diminished one third, and no throbbing could be distinguished in the neighbouring arteries. The ear was now kept compressed between two masses of charpie. On the 46th day Dupuytren tried what benefit would result from pressing the blood out of the tumour, and then covering it with plaster of Paris. This, however, soon cracked in various places, and could not be kept on the part. An instrument was then contrived for the reception and compression of the ear. This had the effect of restraining the enlargement of the ear, but was found inadequate to destroy the erectile tissue, which still continued, notwithstanding the pulsation of the arteries had ceased. To have got rid of this portion of the disease, observes Dupuytren, it would have been necessary either to remove the tissue composing it, or to change its organization. The first plan, on account of the extent of the disease, he did not consider safe; nor could he alter the nature of the disease.

The history of the foregoing case, resumed fifteen years after the operation, proves that though tying the carotid artery is less efficacious in curing a tumour composed of erectile tissue, than a common aneurism, yet it checks its progress, and diminishes its danger. After the carotid artery had been tied in the preceding case, the tumour made little or no progress; the size of the ear remained stationary; and no return of hemorrhages took place. But whatever may be the degree of benefit resulting from the plan of tying the principal artery leading to the disease, Dupuytren gives it as his decided opinion, that it ought to be resorted to when an erectile tumour has invaded a part, where compression, cauterisation, and extirpation with the knife, are all impracticable. If there be no carcinomatous tissue blended with the erectile, the progress of the disease will, at all events, be retarded by the operation. (See *Dupuytren, Clinique Chir.* t. iv. p. 5—26.; and *Breschet's Transl. of Hodgson's Treatise*, t. ii. p. 296.) The experiment has been made of tying both carotids, where the ligature of one proved insufficient to prevent the return of pulsation in the arteries immediately supplying the tumour. Dr. Mussey, of New Hampshire, in America, was consulted in September, 1829, by J. Patce, aged 20, for a large pulsating purple tumour, situated upon the vertex of the head, with a base of about five inches in diameter, and rising about two inches above the cranium. The tumour, which had existed from infancy, had greatly increased during the three years anterior to the above date. Upon its apex was an ulcer, from which hemorrhages had occasionally taken place, and once to the amount of two quarts, "The left temporal artery and vein in front of the ear, seemed through the integuments five eighths of an inch in diameter, and the pulsations of the artery were visible at the distance of fifteen feet. A vein, passing from the tumour, down the forehead, was half an inch in diameter; and when the head had been shaved, more than twenty pulsating arteries were seen running to the tumour, none of which were under the size of a goose-quill. Dr. Mussey, on the 20th of September, tied the left common carotid; and finding this effectual, he applied a ligature to the right one, twelve days after the first operation. The tumour was covered with a compress moistened with alum-water, and gentle pressure maintained with a bandage. In about three weeks from the period of the second operation, the swelling was not above one third of its original size. Five or six days later, it began very slightly to enlarge again; its colour became deeper; and a feeble thrill was sometimes perceptible in the left temporal artery. As Dr. Mussey found that the ligature of the carotid promised no further benefit, he determined to encircle the tumour by incisions, and to dissect it away rapidly from the pericranium. More than an hour was occupied in carrying the knife around the base of the tumour; for only an inch and a half of the scalp was cut at a time, and as soon as this was done, firm compression was made upon each lip of the incision, while the vessels were secured with ligatures, more than forty of which were applied in proceeding round the tumour. Notwithstanding these precautions, nearly two quarts of blood were lost. The patient was faint, and continued very feeble for several hours. The naked pericranium, in extent about twenty-five square inches, granulated favourably, and the part healed up. (See *American Journ. of Med. Sciences for Feb.* 1830.)

This case is instructive, as proving still more convincingly than perhaps any other case on record, that tying the carotid artery will not completely cure an aneurism by anastomosis on the head, though the plan has generally succeeded for swellings of this description in the orbit. The ligature, even of both carotids, in Dr. Mussey's case, did not prevent the return of pulsation in the temporal artery; and this unpromising circumstance led him to adopt, without delay, the plan of encircling this disease by a succession of short incisions, in the way practised by Dr. Gibson. Time was not afforded to see whether the growth of the tumour would have been permanently checked, and the return of hemorrhages prevented by the ligature of both carotids, as happened in Dupuytren's case from the ligature of one of them. An interesting question here is, whether the ligature of the carotids made the final excision of the tumour safer, with respect to hemorrhage? Without this preliminary measure, Dr. Gibson, we find, accomplished what Dr. Mussey did with it.

Some aneurisms by anastomosis, on or near the surface of the body, may be extirpated with a ligature. A needle, armed with a double ligature, is passed under the erectile tissue. As it is of importance that the ligature go more deeply than the deepest part of the swelling, the assistant ought to raise up the tumour from the subjacent parts, while the needle is pushed under its base. The needle having been cut off, one portion of the ligature is firmly tied over one half of the circumference of the swelling, and the remaining part of it over the other half. Thus the supply of blood to the swelling is completely cut off. After a few days, the diseased mass and the ligatures are detached by an ulcerative process; and, as Mr. Guthrie observes, if the disease has been completely removed, the ulcer heals without difficulty, and the scar is often less, than if the operation had been done with the knife. If the disease should not be completely removed, a second ligature may be applied, or, as I have sometimes preferred, the remains of the disease may be extirpated with caustic and pressure. We are informed that this method has been followed, for many years, by the surgeons of the Westminster Hospital. Mr. Keate has made an improvement in it, which consists in employing pins, which, by being passed across, but underneath the tumour, admit of compression being made around a larger surface than could otherwise be included in the ligature. (See *Guthrie, On Dis. of Art.* p. 346.) In one case, thus treated by Sir Benjamin Brodie, where the size of the swelling, which was on the forehead, was too extensive to be embraced with a needle and double ligature in the common way, he used straight pins, like those for the hair-lip, which, being pushed under the disease at right angles, enabled him to pass a ligature around the base of it. In this instance it became necessary to employ a second set of pins and a second ligature; but the cure was ultimately complete. (See *Brodie*, in *Med. Chir. Trans.* vol. xv. p. 177.)

An infant, six weeks old, was brought to Mr. Wardrop, on account of an aneurism by anastomosis (a subcutaneous nævus) of a very unusual size, situated on the left cheek. The base of the tumour extended from the temple to beyond the angle of the jaw, completely enveloping the cartilage of the ear. At its upper part, there was an ulcer, about three inches in diameter, presenting a sloughing appearance. The tumour was soft and doughy; its size could be much diminished by pressure; there was a throbbing in it, and a strong pulsation in the adjacent vessels. The disease was daily increasing, and several profuse hemorrhages had taken place from the ulcerated part. Mr. Wardrop knowing, from the case to which I have already adverted, the danger of attempting to extirpate so large a tumour of this nature, was led to try what benefit might be obtained by tying the carotid artery. A few hours after this operation, the tumour became soft and pliable; its purple colour disappeared, and the tortuous veins collapsed. On the second day, the skin had resumed its natural pale colour, and the ulceration continued to extend. On the third, the tumour still diminished. On the fourth, the swelling had considerably increased again; the integuments covering it had become livid, and the veins turgid. The inosculating branches of the temporal and occipital arteries had become greatly enlarged. . A small quantity of blood had oozed from the ulcer. After remaining without much alteration, the tumour on the seventh day had again evidently diminished. On the ninth, the ulceration was extending itself slowly, and the tumour was lessened fully one half. On the twelfth, the child's health was materially improving. The auricular portion of the swelling had now so much diminished, that the cartilage of the ear had fallen into its natural situation. After poultices had been applied for two days, the central portion of the swelling, which appeared like a mass of hardened blood, was softened, and Mr. Wardrop removed considerable portions of it. On the thirteenth, the child became very ill, and died the following day, exhausted by the irritation of an ulcer, which had involved the whole surface of an enormous tumour. Mr. Wardrop thinks the advantages likely to occur from the plan of tying the main arteries supplying tumours of this nature with blood are, the diminution of the size of the disease; the lessening of the danger of hemorrhage, if the ulcerative process has commenced; and the rendering it practicable to remove the swelling with the knife, though the operation may previously have been dangerous, or impracticable. (See *Med. Chir. Trans.* vol. ix. p. 206—214, &c.)

In the foregoing part of this article, I mentioned the trial of the method of securing the principal branches of the external carotid distributed to the tumour. This plan has generally failed, and it did so in the example under Dupuytren, who, therefore, decided to take up the common carotid itself. Dr. Gibson, in his Institutes of Surgery, however, relates a case, in which the practice succeeded. The patient, a woman, had a large pulsating tumour, which covered almost the whole of the right side of the head, and often bled profusely. Dr. Gibson began with cutting off the supply of blood to the tumour through the occipital and temporal arteries. The swelling now lessened, and its pulsations became weaker; but, as this amendment was only temporary, he proceeded to divide the parts situated between the former incisions, and to tie the vessels. The first cut was two inches in length, and a great deal of blood was lost before all the vessels were secured. The second cut was three inches in extent; but so much blood was now lost, that it became necessary to postpone the completion of the operation. After twelve days, the incisions were extended again; and, at the end of the fortnight, the circumvection of the wound was completed, and the tumour removed; the periosteum being left, from which granulations soon arose, and, in a few weeks, the wound was healed.

Aneurism by anastomosis, when situated on the fingers, may render amputation of them indispensable, provided the whole of the disease cannot be got rid of by other means. I once saw, with Mr. Lawrence, an aneurism by anastomosis, situated on the ring finger of the right hand, in a young woman, about twenty years of age. The disease was attended with painful sensations, extending to various parts of the limb and the breast, and the arm was disqualified for any kind of exertion. In January, 1815, Mr. Hodgson had taken up the radial and ulnar arteries, and the first consequences of the operation were an entire cessation of beating, collapse of the swelling, and relief from pain; but these symptoms all recurred in a few days. Finding compression unavailing, and the sufferings of the patient increasing, Mr. Lawrence proposed amputation of the finger at the metacarpal joint; but, as this suggestion was not approved of, he recommended the patient to try the effects of a division of all the soft parts, by a circular incision close to the palm, so as to cut off the supply of blood. This operation Mr. Lawrence performed, in the presence of Mr. George Young and myself, in as complete a manner as can possibly be conceived.

All the soft parts, excepting the flexor tendons, with their thecæ and the extensor tendon, were divided. The digital artery, which had pulsated so evidently in the palm of the hand, was fully equal in size to the radial, or ulnar of an adult, and was the principal nutrient vessel of the disease. After tying this and the opposite one, we were surprised at finding so strong a jet of arterial blood from the other orifices of these two vessels, as to render ligatures necessary. I can here only add, that the whole finger beyond the cut swelled very considerably; the incision healed slowly; the swelling subsided, but did not entirely disappear; the integuments recovered their natural colour; the pulsation and pain were removed; and the patient so far recovered the use of her arm, that she could work at her needle for an hour together, and use the arm for most purposes. (See *Wardrop's Obs. on one Species of Nævus,* in *Med. Chir. Trans.* vol. ix. p. 216.)

Mr. Russell, an army surgeon, has lately published some interesting particulars of an aneurism by anastomosis of the hand. The patient (a laundress), aged 41, had two tumours, each about the size of a walnut; one at the extremity of the ring finger, the other on that of the little finger of the left hand. They extended along each finger to the middle of it, and were of a violet colour, spongy feel, and of a structure resembling placenta. They shrunk under pressure, but recovered their size on its being removed; throbbed strongly, as did all the vessels of the arm; were excessively painful, and attended with irritability of the whole frame. The radial and ulnar arteries were enlarged, the latter tortuous; and the basilic vein had a varicous appearance. The disease had existed five years, and bled freely and frequently. Mr. Russell recommended the removal of the two fingers at the metacarpal joints, which the woman objected to. In about two months, however, she returned, willing to undergo any operation which Mr. Russell deemed necessary. The disease had now extended itself, so as to form one aneurismal tumour at the commissure of the two fingers. The placenta-like appearance reached to the wrist; the arm was of an erythematous hue to the elbow; the tumours had ulcerated and sloughed; and the carious phalanges protruded from the gangrenous fingers, which were enlarged, and dreadfully painful. The increased pulsation and magnitude of the arteries extended to the axilla. Mr. Russell first tied the ulnar artery, and then amputated the ring and middle fingers, with their metacarpal bones, at the carpus. The stump healed well; and a valuable portion of the hand was saved. Three years after the operation, the vessels of the arm had resumed their natural appearance, and the woman was able to follow the business of a laundress. This case Mr. Russell believes unusual, as having occurred in a person of advanced life; and he considers, that it exemplifies the truth of Mr. Wardrop's observation, that a ligature on the artery, leading to the disease, may render the excision of it practicable, when this proceeding would otherwise be unsafe. However, Mr. Russell took up the ulnar artery, he says, for a different purpose; namely, that of enabling him to cut close to the disease. The case proves also, that the secondary effects on the surrounding parts, and, especially, the extensive enlargement of the blood-vessels, will subside after the excision of the erectile tumour. (See *J. Russell,* in *Lond. Med. Gaz. for April,* 1836.)

Most of those aneurisms by anastomosis which admit of being extirpated by a ligature, may also be destroyed with strong caustic, like pure potassa, the liquid nitrate of mercury, &c. This plan, which was particularly recommended by Mr. Wardrop, and is an old practice, was sometimes adopted by Dupuytren. I have followed it in some instances, and found it answer, though the necessity of repeating the application several times makes it a more tedious method of cure than the ligature. I lately attended a child with Mr. Jephson, of Hampton, for a large thick nævus on the forearm: in this instance, the caustic answered exceedingly well, but it was indispensable to apply it several times. It seems to act partly by converting portions of the tumour into sloughs, and partly by exciting an ulcerative process in the remainder. In the North London Hospital, there was a lad about a twelvemonth ago for a large erectile tumour on the side of the head. Mr. Liston attacked parts of it with caustic in succession, but the patient left the hospital before the plan had been carried to the extent intended. Dupuytren regarded the actual cautery as a still surer means of extirpating erectile tumours than caustic, though rarely employed, on account of the terror which it excites. (*Clin. Chir.* t. iv. p. 33.) The acid nitrate of mercury was the caustic which he was in the habit of using. (*Op.* cit. p. 28.)

Whatever will change the texture by exciting a general and severe inflammation of an erectile tumour, and an obliteration or annihilation of its vessels, will effect a cure. The treatment on this principle is sometimes practicable. Thus, swellings, composed of erectile tissue, have occasionally been cured by compression; a plan, which Abernethy wrote in favour of, and which both he and Dupuytren tried in several instances with success. The latter sometimes applied this method to the lips, the diseased portion of which was placed between a compressing instrument.

On the principle of changing the organization of the erectile tissue, and converting it into the fibrous, M. Lallemand has treated certain tumours of this description very successfully by exciting inflammation in them by the introduction of pins through them. One of his most interesting cases is that of an infant three months old, which had an erectile tumour over the scapula, three inches in length and two in diameter, with a red granular surface. Compression had been tried in vain. M. Lallemand first introduced a dozen fine pins through the inferior portion of the tumour, and covered the spaces between them with waxed thread variously twisted. Three days afterwards, a similar operation was repeated on the opposite side. The pins were left in their places seven or eight days, till they had excited sufficient inflammation. The rest of the tumour was afterwards attacked, and in the course of two months and a half, after 120 pins had been introduced at successive periods, a cure was effected, without the loss of a spoonful of blood, a uniform glossy cicatrix being left. Long fine pins, such as are used for transfixing insects, are preferable to common sewing needles. (See *Lallemand,* in *Archives Gen. de Méd.* t. viii. sér. 2.) On the same principle of exciting inflammation, and changing the texture of erectile tumours, cures have occasionally been accomplished by passing a couching-needle into them, and breaking up their structure. Stimulating injections have likewise been thrown into their substance with the same view. (*Lloyd* in *Med. Gaz. for* 1836-37.) Most of these latter methods seem to me only eligible when the tumour is of limited size, and its base not too deep.

Erectile tumours are more frequently noticed on the lips than any other part of the body, a circumstance ascribed by Dupuytren to their spongy vascular structure (*Clin. Chir.* t. iv. p. 51.) But, they have been met with in the arm, forearm, hand, fingers, thigh, instep, scalp, ear, cheek, labia pudendi, substance of the skin, muscles, periosteum, bones, kidney, liver, &c. In the work last cited, reference is made to an example where the skin, muscles, and bones of the upper extremity, all became affected from the fingers to the shoulder, (t. iv. p. 52.)

Besides the varieties of aneurism particularly treated of in the foregoing columns, there is another rarer form of the disease, named by Breschet *cirsoid aneurism* (from κιρσός, a varicous vein, and εἶδος, like); and by Dupuytren, *arterial varix*, in consequence of its resemblance to a varicous vein. It consists in the dilatation of an artery in the greater or lesser portion of its extent, and frequently through the whole of an arterial trunk and its branches. In addition to the transverse dilatation, the artery is elongated and tortuous, so as to describe bendings and windings in various degrees. Independently of these dilatations of the whole arterial tube, nodosities, or small circumscribed aneurismal tumours, present themselves, which are true sacciform aneurisms, and occasionally mixed ones. Most commonly, the coats of the vessel are thinned and softened, and, when divided, collapse like those of varicous veins: as Breschet observes, an artery affected in this manner, may easily be mistaken for a varicous vein. The disease has been noticed in the iliac, carotid, brachial, femoral, and tibial arteries, and also in some of less size; such as the occipital, the auricular, radial, ulnar, palmar, plantar, and ophthalmic. This kind of arterial disease, according to Breschet, accompanies an aneurismal varix of long standing. The arterial varix, like the venous aneurismal varix, has been suspected to be attended with some communication between the two orders of vessels, and the passage of a certain quantity of venous blood into the dilated varicous artery. But pathologists have not yet been acquainted with the disease long enough to know its nature perfectly. Some interesting examples of it, illustrated by engravings, are recorded by Breschet. (See *Mém. Chir. &c.*)

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ANTHRAX (ἄνθραξ, a burning coal). See Carbuncle.

ANTIMONY. Antimonial medicines are prescribed in a great number of surgical cases, and I may say very commonly in all, where it is desirable to promote the secretions in general, and those of the skin and bowels in particular. Hence, in the treatment of phlegmonous and erysipelatous inflammation, antimony, especially the tartrate of it, or tartarised antimony, is a valuable medicine. In this work, there is no occasion to notice the usefulness of tartarised antimony as an emetic. In inflammations of the brain and its membranes, the eye, the testicles, and the synovial tissues, surgeons frequently prescribe it with great advantage to the patient. Rasori, an Italian physician, used to order it in very large doses, as a means of keeping down inflammation of important organs; and the success of this treatment, as compared with that resulting from the free employment of the lancet, has excited a great deal of attention. The disturbance of the stomach, which was at first severe, afterwards generally subsided, and that organ seemed to bear the medicine well. In this country, the tartrate of antimony is sometimes employed in cases of dislocation, where the muscles make powerful resistance to the reduction: here it is prescribed in small doses, repeated every five or ten minutes, until a good deal of nausea is excited, or the patient actually vomits. In this state the patient becomes exceedingly faint, and the muscles no longer oppose the efforts of the surgeon to reduce the dislocated bone. (See Dislocation.) With this view, half a grain, dissolved in distilled water or in the form of the vinum antim. tart., may be given every five minutes, till the desired effect takes place. In doses of one sixth or one fourth of a grain, joined with calomel and opium, the tartrate of antimony operates as a diaphoretic, and this combination is useful in various cases of inflammation, which are within the province of surgery. Tartarised antimony, in the proportion of ʒj to ℥j of lard, makes what is termed the antimonial ointment, which, where it is desirable to keep up counter-irritation on the surface of the body, is rubbed upon the part in the quantity of about a drachm, and for a few minutes at a time. The effect is to bring out pustules, and even ulceration, the degrees of which, and their influence on the complaint, are to determine how often and long the antimonial frictions are to be continued. In some cases, these excite pustules and ulceration in distant parts; a fact deserving to be particularly remembered.

Instead of the pulvis antimonialis (L. P.) the best practitioners now usually prescribe either tartarised antimony, or James's powder. In fact, doubts are entertained about the efficacy of the common antimonial powder. Dr. Elliotson prescribed it in a dose of more than 100 grains, and it seemed to have no effect. This inertness of the preparation was believed by Mr. R. Phillips to depend upon its being a peroxide. (See *Annals of Philosophy for Oct.* 1822; and *Pharmacol. by Dr. Paris*, p. 357. vol. ii. ed. 5. 1822.) In general, says Dr. A. T. Thomson, it displays no influence whatever on the system. Its occasional activity may be ascribed to the oxide being accidentally in the state of a protoxide. (See *Thomson's Elem. of Mat. Med.* p. 923. ed. 2.) Hence, when antimonials are indicated in surgery, for the purpose of promoting the secretions generally, and of the skin in particular, it is best to prescribe either tartarised antimony or James's powder. The dose of the latter is from four to ten grains; and it may be combined with calomel, or opium, or both, according to the indications of the case.

The precipitated sulphuret of antimony is only prescribed as an ingredient in the compound calomel pill.

The muriate of antimony, termed butter of antimony, from its consistence, is a powerful caustic, more frequently employed by foreign than British surgeons, who, in consequence of its deliquescent character, consider it an inconvenient application.

ANTRUM, *Diseases of*. The diseases to which the antrum, or maxillary sinus, is liable, commence either in its mucous lining, the bony laminæ of which it is composed, or the fangs of the teeth, which form projections at the lower part of it. Sometimes the mucous membrane inflames, and, becoming thickened, closes the natural opening, by which the antrum communicates with the nasal fossæ, and the consequence is an accumulation of mucus or limpid fluid in it. On other occasions a purulent fluid is secreted; or a fluid is formed, which concretes into small masses, and has the characters of adipocire. The antrum may also be the seat of polypi, sarcomatous tumours of various descriptions, erectile tumours, or aneurism by anastomosis, and scirrhous swellings. Then its bony parietes may be softened, more or less absorbed, or carious, or affected with necrosis or exostosis. (See *Gensoul, Sur Quelques Maladies, Graves du Sinus Maxillaire, &c.* p. 2. 8vo. Paris, 1833.) Sometimes extraneous bodies, detached portions of bone, a bullet, and even insects, may lodge in the antrim, and cause, for many years, very afflicting pains.

Collection of Mucus.

In general, this disease, which is not very common, takes place unpreceded by any causes which are at all manifest. It is alleged mostly to happen in young subjects: of three patients seen by Boyer, the eldest was not more than twenty. (*Traité des Mal. Chir.* t. vi. p. 139.) Sir Benjamin Brodie has seen only two cases: one patient was a lady, whose age is not specified; the other, a boy. A collection of transparent fluid in the antrum is undoubtedly a much rarer occurrence than one of pus. (See *Brodie*, in *London Med. Gaz. for Dec.* 1834.) As Mr. Hunter has noticed, whether the obliteration of the duct, leading to the nose, be a cause or only an effect of the disease, is not easily determined; but from some of the symptoms, there is great reason to suppose it an attendant. "If it be a cause, we may suppose that the natural mucus of this cavity, accumulating, irritates, and produces inflammation for its own exit, in the same manner as an obstruction to the passage of the tears through the ductus ad nasum produces an abscess of the lachrymal sac." (See *Hunter's Natural Hist. of the Teeth*, p. 174. ed. 3.) A most interesting example of the effects of the lodgment of mucus in the antrum, is that recorded by Dubois: a boy, between seven and eight years of age, was observed to have at the base of the ascending process of the upper jaw-bone, on the left side, a small, very hard tumour, of the size of a nut. As it gave no pain, and did not increase, his parents gave themselves no concern about it. When he was about sixteen, however, the swelling began to increase, and to be somewhat painful. Before he was eighteen, its augmentation was so considerable, that the floor of the orbit was raised up by it; the eye thrust upwards, and nearly closed; the arch of the palate pushed down in the form of a tumour; and the nostril almost effaced. Below the orbit, the cheek made a considerable prominence; while the nose was thrown towards the opposite side of the face, and the skin at the upper part of the tumour, below the lower eyelid, was of a purple red colour, and threatening to burst. The upper lip was drawn upwards, and behind it; all the gums on the left side were observed to project much further than those on the opposite side of the face; and, at this point alone, the thinness of the bony parietes of the antrum was perceptible. The patient spoke and breathed with great difficulty; he slept uneasily, and his mastication was painful. The case was at first supposed by Dubois, Sabatier, Pelletan, and Boyer, to be a fungus of the antrum, and an operation was considered advisable. In proceeding to this measure, the first thing, which attracted the notice of Dubois, was a sort of fluctuation in the situation of the gum, behind the upper lip; a circumstance which led him to give up the idea of the case being a fungus, though he expected that, on making an opening, merely a small quantity of ichorous matter would escape, affording no kind of information. In this place, however, he determined to make an incision along the alveolary process, whereby a large quantity of a glutinous substance, like lymph, or what is found in cases of ranula, was discharged. A probe was now introduced, with which Dubois could feel a cavity equal in extent to the forepart of the tumour; and in moving the instrument about, with the view of learning whether any fungus was present, it struck against a hard substance, which felt like one of the incisor teeth, near the opening that had been made. Five days after this first operation, Dubois extracted two incisors and one grinder, and then removed the corresponding part of the alveolary process. As the hemorrhage was profuse, the wound was now filled with dressings, which in two days came away, and enabled Dubois to see with facility all the interior of the cavity. At its upper part, he perceived a white speck, which he supposed was pus; but, on touching it with a probe, it turned out to be a tooth, which was then extracted, in doing which some force was requisite. The rest of the treatment merely consisted in injecting lotions into the cavity, and applying common dressings. In about six weeks, all the hollow disappeared; but the swelling of the cheek and palate, and the displacement of the nose, still continued. In the course of another year and a half, however, every vestige of deformity was entirely removed. (*Dubois, Bulletin de la Faculté de Méd.* an. 13. No. 8.)

In the case of the lady attended by Sir Benjamin Brodie, there was no distinct fluctuation, but a kind of crackling sensation communicated to the fingers, like what would be felt in pressing upon very thin horn, or parchment. (*Med. Gaz. loc. sit.*)

With respect to the treatment of collections of mucus, or transparent albuminous fluid, in the antrum, by means of injections, thrown into that cavity through the natural opening in it, while the head is inclined to the opposite side, for the purpose of facilitating the escape of the collected fluid, as proposed by Jourdain in 1765 (*Mém. de l'Acad. de Chir.* t. iv. p. 357.), I fully agree with Deschamps and Boyer, that the method is a bad one; because long before the disease forms an outward swelling, we may presume that the natural communication between the antrum and the nostril is closed, and will not readily admit of a tube being introduced into it. Some plan, more fraught with promptitude and efficiency, is here demanded. Hence, the practice of opening the tumour in an eligible place, and to an extent sufficient for the discharge of the mucus, and the prevention of another accumulation, is what all surgeons of the present day recommend. (*Deschamps, Traité des Maladies des Fosses Nassales, et de leur Sinus*, p. 231. 8vo. Paris, 1804; *Boyer, Traité des Mal. Chir.* t. vi. p. 145. 8vo. Paris, 1818.) Indeed, that Jourdain's proposal was attended with too much difficulty for common practice, was the sentence long ago pronounced upon it by a committee of the Royal Academy of Surgery in France. If the case has not destroyed, or softened the front or lower portion of the bony texture of the antrum, and any bad tooth is situated under it, this should be extracted, and a perforation made into the antrum through the bottom of the socket. This aperture may be preserved as long as necessary, by the introduction of a piece of elastic gum catheter, which is to be fastened to the adjacent teeth, and through which the secretion in the antrum may escape, and lotions be injected. (See *Deschamps, Traité des Mal. des Fosses Nasales, &c.* p. 234.) However, as Hunter remarks, if the forepart of the bone has been destroyed, even though the case be merely a collection of mucus, or pus, an opening may be made on the inside of the lip; but, from a fear that there would be difficulty in maintaining such an aperture, he still inclines to the practice of drawing one of the teeth. (*Natural History of the Teeth*, p. 176. ed. 3.)

In general, I believe that the extraction of one of the molar teeth will not prove very applicable to the present case; first, because the thick albuminous fluid requires a larger opening than can be thus obtained: and secondly, because when the surgeon is called upon to perform an operation, the bony texture of the antrum is already very thin, much softened, or even partially absorbed above or behind the alveoli; consequently, as soon as the surgeon has made an incision, above the gum, or in the part of the swelling presenting itself on the roof of the mouth, he finds that a probe will immediately enter the antrum. All that he has to do, therefore, is to enlarge this opening with a small pair of bone-pliers, or a strong knife. Mr. Hunter's apprehension about the difficulty of maintaining the opening, and of the likelihood of a return of the accumulation, does not appear to be confirmed by what happened in the cases under Dubois and Sir Benjamin Brodie. The latter informs us, that, "after dissecting the membrane of the cheek from the jaw, I took a curved scalpel, bent laterally, with a strong sharp point, and introduced the point into what seemed the thin bony parietes, or boundary of the tumour. Immediately there escaped a large quantity of transparent fluid, like very thin mucus, something like what we find in cases of ranula. I then introduced a probe into the cavity of the antrum, and found that it might be passed in any direction. There was neither tumour nor dead bone in it; and the cavity seemed to be in a natural state, except that it was enormously dilated. I next enlarged the opening, cutting out a circular portion of thin bony shell, formed by the expanded parietes of the antrum. After the operation, the tumour subsided, and, in a few weeks, the cheek was not larger than the other. The aperture made by the scalpel has continued pervious to this day, though it is ten years since I performed the operation. The lady wears a plug, which she takes out night and morning, and with her own hand introduces the point of a syringe, and washes out the antrum." (See *Lond. Med. Gaz. for Dec.* 1834.)

Abscesses of the Antrum.

Abscesses are far more common than collections of mucus. Violent blows on the cheek, inflammatory affections of the adjacent parts, and especially of the pituitary membrane lining the nostrils, exposure to cold and damp, and, above all things, bad teeth, may bring on suppuration within the antrum. The first symptom is pain, often imagined to be toothach, particularly if there should be a carious tooth in this part of the jaw. Such pain, however, extends more into the nose, than that usually does which arises from a decayed tooth; and affects the eye, orbit, and frontal sinuses. (See *Hunter on the Teeth*, p. 175. ed. 3.) But these symptoms are insufficient to characterise the disease, the nature of which is not unequivocally evinced till a much later period. Sir Benjamin Brodie adverts to inflammation of the antrum, independent of local causes; a case more obscure than when some manifest local cause of irritation is present. In one such example, he was led to make a perforation above the second molaris, but no pus escaped. The patient was relieved by taking two grains of calomel and half a grain of extract of opium three times a day till the gums had become rather sore. (*Brodie*, in *Lond. Med. Gaz. for Dec.* 1834.) An inflammation of the antrum, tending to suppuration, is generally of longer duration than one entirely dependent on a caries of a tooth. There is a constant dull pain in the cheek, with frequent paroxysms of lancinating torture, and a great deal more sympathetic febrile disturbance than attends toothach; and the violence of the suffering increases more and more, until, at last, a hard tumour is perceptible below the cheek-bone. By degrees the swelling extends over the whole cheek; but it afterwards rises to a point, and forms a circumscribed hardness, perceptible above the back grinders. This symptom is accompanied with œdema, redness, and sometimes with suppuration of the external parts. In some instances, when there is an outward abscess, the matter has made its way into that situation through the bone, and there is consequently a communication between both collections of matter.

The circumscribed elevation of the tumour, above the molares, does not, however, occur in all cases; for sometimes the matter makes its way towards the palate, causing the bones of this part to swell, and, at length, bringing them into the state of caries, or necrosis, unless timely assistance be given. In some other cases, the matter escapes between the fangs and sockets of the teeth, and causes a soft prominent swelling in the gums. Lastly, there are certain examples, in which the matter passes into the nostril of the same side, when the patient is lying with his head on the opposite one. If this mode of evacuation should be frequently repeated, it affords relief, and prevents the tumour both from pointing externally, and bursting, as it would do if the purulent matter could find no other outlet. But this evacuation of pus from the nostril is not so common as might be expected; for, according to Mr. Hunter, the opening between the antrum and cavity of the nose is generally stopped up. He even seems inclined to think, as I have already observed, that the disease may sometimes be occasioned by the impervious state of this opening, in consequence of which the natural mucus of the antrum collects in such quantity, as to irritate and inflame the membrane with which it is in contact, just as an obstruction in the ductus nasalis hinders the passage of the tears into the nose, and causes an abscess in the lachrymal sac. This is a point, however, on which even Mr. Hunter would not venture to speak with certainty; for it is by no means impossible, that the impervious state of the opening is rather an effect, than the cause, of the disease, since inflammation in the antrum is often manifestly produced by causes of a different kind, and the opening in question is not invariably closed.

Sir Benjamin Brodie concurs with other surgeons in believing that inflammation of the antrum is mostly dependent on local causes, and more commonly upon the irritation of a bad tooth than any other circumstance. This gives rise to inflammation at the bottom of the alveolus. Here matter forms; and not always being able to escape between the fang and the socket, destroys the periosteum lining the latter part, causes absorption of the bone, and the inflammation is propagated to the lining of the antrum. In many instances, the case becomes complicated with dead as well as carious bone. (See *Brodie*, in *Lond. Med. Gaz. for Dec.* 1834.)

In the early stage of these cases, leeches, fomentations, calomel, opium, and saline purgatives may be employed for the purpose of reducing the inflammation, and preventing its advance to suppuration. But, when an abscess has formed, and the matter is confined in the antrum, the indications dictate other treatment. The matter should be discharged, and any source of local irritation, which is discoverable, removed.

Abscesses in the antrum require a free outlet; and, if the surgeon neglects to procure it, nature herself ultimately does what is requisite; but not till the patient's agony has been greatly prolonged, and the disease has extended further than it ought to have been allowed. At length, however, the pus makes its appearance, either towards the orbit, the alveoli, the palate, or, as is mostly the case, towards the cheek. The matter having thus made its escape from the antrum, bursts through the soft parts, and the disease now becomes fistulous.

In all cases, whether the pus be simply confined in the antrum, or whether the case be conjoined with a necrosis, or caries, the principal indication is to discharge the matter.

The ancients seem to have known very little about the treatment of diseases of the antrum. Drake, an English anatomist, is reputed to be the first proposer of a plan for curing abscesses of this cavity. (*Anthropologia Nova.* Londini. 1727.) However, Meibomius was much earlier in proposing, with the same intention, the extraction of one or more of the teeth, in order that the purulent matter might escape through the sockets.

Drake, and, perhaps, before him, Cowper, aware that the fangs of the teeth did not reach completely into the antrum, proposed making a perforation through the socket into that cavity, for the purpose of letting out the matter, and injecting such fluids as were judged proper.

In the treatment of abscesses of the antrum, the extraction of one or more teeth, and the perforation of the alveoli, being generally essential steps, the first question is, what tooth ought to be taken out. In general, caries, or even a mere continual aching of any particular tooth, ought to decide the choice. But, if all the teeth should be sound, which is not often the case, writers direct us to tap each of them gently, and to extract that which gives most pain on this being done. When no information can be thus obtained, other circumstances ought to guide us. All the grinding teeth, except the first, correspond with the antrum. They even sometimes extend into this cavity, the fangs being then only covered by the pituitary membrane; and the bony lamella, which separates the antrum from the alveoli, is always very thin towards the back part of the upper jaw. Hence, when the choice is in our power, it is best to extract the third or fourth grinder, as, in this situation, the alveoli can be more easily perforated. Though, in general, the first grinder and canine tooth do not communicate with the antrum, their fangs approach the side of it, and from their socket an opening may readily be extended into that cavity.

When one or more teeth are carious, they should be removed, because they are both useless and hurtful. The matter frequently makes its escape, as soon as a tooth is extracted, in consequence of the fang having extended into the antrum, or rather in consequence of its bringing away with it a piece of the thin partition between it and the sinus; or the discharge may follow from the partition itself being carious. If the opening, thus produced, be sufficiently large to allow the matter to escape, the operation is already completed. But, as it can easily be enlarged, it ought always to be so when there is the least suspicion of its being too small. However, when no pus makes its appearance after a tooth is extracted, the antrum must be opened hy introducing a pointed instrument in the direction of the alveoli. For this purpose a trocar, an awl, or a gimlet, may be employed.

Sir Benjamin Brodie prefers an instrument, formed like a common hydrocele trocar, but a little larger, and of course without a cannula. "It should not be made of the best steel; for (says he) I once used a common trocar, made of steel, and it broke while I was performing the operation. In this case, I extracted the broken portion very easily; but such an accident might occur, and great difficulty be experienced in extracting the point of the instrument. When the bottom of the alveolus is broken down, the matter will readily escape from the antrum, and you may introduce a probe, and explore the cavity, so as to ascertain whether there be in it any dead bone, or not. Sometimes there is a piece of dead bone at the bottom of the alveolus, and then you have only to wait patiently till an opportunity occurs for its removal. At other times, you will feel the dead bone, after the probe has entered the antrum, and the opening already made may not be sufficient for its extraction. Under these last circumstances, the opening must either be enlarged, or another made in a different place." (*Brodie,* in *Lond. Med. Gaz. for Dec.* 1834.)

The patient should sit on the ground, in a strong light, resting his head on the surgeon's knee, who is to sit behind him. Immediately the instrument has reached the cavity, it is to be withdrawn. Its entrance into the antrum is easily known by the cessation of resistance. After the matter is discharged, surgeons advise the opening to be closed with a wooden stopper, in order to prevent the entrance of extraneous substances.

The stopper is to be taken out, two or three times a day, to allow the pus to escape. If there be no dead bone present, this plan soon disposes the parts affected to discontinue the suppuration, and resume their natural state. The cure may often be accelerated by employing injections of weak brandy and water, lime-water, or a solution of the sulphate of zinc. Two or three days after an opening has been made into the antrum, Sir Benjamin Brodie begins to wash out the cavity, once or twice daily, with tepid water, injected by means of a syringe with a slightly curved pipe. The water injected will now generally pass into the nostril, and the cavity can be very completely washed out. If the water does not pass out of the nose, it shows that the natural opening between the two turbinated bones is blocked up. (*Brodie, Op.* cit.)

Some surgeons prefer a piece of bougie, or of elastic gum catheter, instead of the wooden stopper. The examples on record, where the extraction of a tooth, and the perforation of the bottom of the antrum, were the means of curing abscesses of that cavity, are very numerous. (See *Farmer's Select Cases,* No. ix.; *Gooch's Cases,* p. 63., new ed.; *Palfyn, Anatomie, &c.*; *Brodie, Op.* cit.)

When the bones are diseased, the simple perforation will not accomplish a cure. A probe will generally detect caries or necrosis. The fetid smell, and ichorous appearance of the discharge, will also leave little doubt that the bones are diseased.

When there are loose pieces of dead bone, or other foreign bodies, to be extracted, it may be requisite to make a larger opening in the antrum than can be obtained through the socket of a tooth. Instances also occur where patients have lost all the grinding teeth, and the sockets are quite obliterated, so that a perforation from below cannot be effected. Some practitioners object to sacrificing a sound tooth. In these circumstances, a perforation in the antrum may be made above the alveolary processes; as first suggested by Lamorier. It consists in making a transverse incision, below the malar process, and above the root of the third grinder. Thus the gum and periosteum are divided, and the bone exposed. A perforating instrument is to be conveyed into the middle of this incision, and the opening in the antrum made of the requisite size with the small pair of cutting pliers, or other convenient instrument. In this way an opening can be more conveniently made than with a trephine. The following way of making the opening is recommended by Sir B. Brodie: "Raise up the cheek, so as to expose the membrane covering the gum on the side of the face, and, with a scalpel, make a transverse incision down to the bone. In one case (says he), I did otherwise, thinking the division of the membrane, as a separate part of the operation, was unnecessary; but, the consequence was, that the blood escaped into the cellular membrane underneath, and there was an immense ecchymosis, rendering the rest of the operation very difficult. Then perforate the thick plate of bone, as nearly as possible to what you suppose to have been the original seat of the disease." The best instrument for this purpose, according to Sir Benjamin Brodie, is a pair of sharp-pointed strong scissors. "Apply them to the bone in their closed state, using them as a chisel, and they will easily penetrate it, and go into the antrum. With these the bone may be broken away to the requisite extent." (See *Mém. de l'Acad. de Chir.* t. iv. p. 351.; *Gooch's Obs., Append.* p. 138.) Some examples occur, where it is absolutely necessary to expose a great part of the surface of the bone, and to cut away the dead pieces which are wedged, as it were, in the living ones. In general, however, it is prudent to wait till the dead bone is loose; and, in the meanwhile, to restrict our interference to preventing the lodgment of matter, and maintaining cleanliness.

Tumours of the Antrum.

Ruysch, Bordenave, Desault, Abernethy, Weinhold, Gensoul, Liston, Regnoli, Guthrie, and others, have recorded examples of various kinds of tumours affecting the antrum. Surgical writers describe polypi of the antrum; and as growths of this kind have their origin from parts invested by mucous membranes, it is natural to expect that the antrum would occasionally be the situation of them. Yet, the disease must here be very rare; and Sir Benjamin Brodie even regards the history and treatment of polypi of the antrum as altogether hypothetical; and he adds, "No polypus, I believe, ever existed in the antrum, around which a surgeon could put a ligature; and I never heard of the operation being performed." (See *Lond. Med. Gaz. for Dec.* 1834, p. 850.) In no hospital, either civil or military, have I had an opportunity of seeing a polypus of the antrum; neither has any case presented itself to me out of an hospital. I join Sir Benjamin Brodie, therefore, in believing the disease to be exceedingly rare. There are, however, some good authorities in confirmation of the fact that polypi do sometimes grow in the antrum. (*Eichhorn, Chelius,* &c.) Certain other tumours, originating within the antrum, are far more common; some of which are of a fibrous, sarcomatous, or osteo-sarcomatous character, free from malignancy; while the others are of a malignant cancerous kind, partaking of the nature of medullary tumours, or of carcinoma, and sometimes of both these formidable diseases together. Malignant tumours are attached to the mucous membrane, and fill up the cavity. At first the patient has but little pain, and the existence of the disease is scarcely indicated by any particular symptoms. But as the disease advances, things are different. The tumour, growing larger, presses upon the inner surface of the antrum, and causes its bony parieties to become dilated. By degrees, it forms a projection in the cheek. After a time, there is another projection in the bony palate. Then another projection occurs at the inferior part of the orbit; and there is still another blocking up the nostril. From the pressure of the tumour, the osseous texture of the antrum is absorbed; the alveoli are destroyed; and the teeth are loosened, or drop out. At length, the morbid growth either makes its way into the orbit, displacing the eye, and then passes through the orbitar plate of the frontal bone into the skull, and proves fatal, or else it protrudes through the front, or lower part of the antrum: in either of which last situations it presents a large fetid, bleeding mass, bringing the patient to his doom with equal certainty. In the Museum of London University College, are three specimens of malignant disease of the antrum; in two, the swelling made its way from the antrum to the brain; in the third, which was taken from an elderly woman, a patient of mine, who died in the North London Hospital, the medullary and scirrhous mass, after entering the orbit, and displacing the eye, caused ulceration and sloughing of the cheek, and a protrusion of some of the tumour in this direction. The woman, who had suffered indescribable agony from the pressure of the tumour, as it continued to enlarge, was at length worn out by the discharge, irritation, and repeated bleedings from the disease. I remember a boy in St. Bartholomew's Hospital, many years ago, in whom a medullary tumour, beginning in the antrum, made its way through the orbitar plate of the frontal bone and cribriform plate of the ethmoid into the cranium. He was only comatose about forty-eight hours before he died, though the portion of the swelling projecting into the cranium, and causing a corresponding depression in the anterior lobes of the brain, was equal in size to a small orange.

The indolence of any ordinary fleshy tumour in the antrum, while in an incipient state, certainly tends to conceal its existence; but such a disease rarely exists a long while without being accompanied with some affection of the neighbouring parts; and hence its presence may generally be ascertained before it has attained such a size as to have altered in a serious degree the natural shape of the antrum. This information may be acquired, by examining whether any of the teeth have become loose, or have spontaneously fallen out; whether the alveolary processes are sound, and whether there are any fungous excrescences making their appearance at the sockets; whether there is any habitual bleeding from one side of the nose, any sarcomatous tumour at the side of the nostril, or towards the great angle of the eye. When the swelling, however, has attained a certain size, the bony parietes of the antrum are dilated, and an extraordinary swelling of the cheek takes place.

A swelling of the parietes of the antrum, in consequence of an abscess, or a sarcomatous tumour in its cavity, may lead us to suppose the case an enlargement of the bones, or an exostosis. The symptoms of the two first affections have been already detailed. One sign of an exostosis, besides the absence of the symptoms characterizing an abscess or a tumour in the antrum, is the thickened parietes of this cavity forming a solid resistance; whereas, in cases of mere expansion, the dimensions of the surface of the bone being increased, while its substance is rendered proportionally thinner, the tumour is softer and more yielding.

When such an exostosis depends upon a particular constitutional cause, and especially upon one of a venereal nature, it must be attacked by remedies suited to this affection. But when the disease resists internal remedies, and its magnitude is likely to produce an aggravation of the case, a portion of the bone may be removed with a trephine, or other cutting instrument.

Mr. B. Bell has described, as a kind of exostosis of the upper jaw, a swelling which, from its history, I presume was really a medullary tumour. In fact, it was attended with such suppleness and elasticity of the bone, that it yielded to the pressure of the fingers, and immediately resumed its former plumpness, when the pressure was discontinued. When the bone was cut, it was found to be as soft as cartilage, and, in an advanced stage of the disease, its consistence was almost gelatinous. The swelling increased gradually, and extended equally over the whole cheek, without becoming prominent at any particular point, or only so in the latter periods of the malady, when the soft parts inflamed, and became affected. The complaint is described as totally incurable. Cutting and trephining the tumour, as recommended in other cases of exostosis, only aggravate the patient's unhappy condition. I have no doubt that the case here depicted was not an exostosis, but a medullary tumour.

Mr. Abernethy published an account of a very singular disease of the antrum. The patient, who was thirty-four years of age when the account was written, perceived, when about ten years old, a small tumour on his left cheek, which gradually attained the size of a walnut, and then remained for some time stationary. About a year afterwards, the tumour having again enlarged, a caustic was applied to the integuments, so as to expose the bone. The actual cautery was next applied, and an opening thus made into the antrum. After the exfoliation, the antrum became filled with a fungus, which rose out upon the cheek, and could not be restrained by any applications. Part of the fungus also made its way into the mouth, through the socket of the second tricuspid tooth, the other teeth remaining natural. The disease continued in this state nine years, occasionally bleeding in an alarming way. When the patient was in his twentieth year, the whole fungus sloughed away during a fever, and never returned. After this, the sides of the aperture in the bone began to grow outwards, forming an exostosis, which rapidly attained a great magnitude. A small exostosis took place in the mouth, but became no larger than a horsebean. The exostosis of the maxillary bone was of an irregular figure, and projected from the whole circumference of the aperture a great way directly forward. Mr. Abernethy compared its appearance, when he was writing, with that of a large tea-cup fastened upon the face, the bottom of which may be supposed to communicate with the antrum. The diameter of the cup, formed by the circular edge of the bone, was three inches and a half; the depth two inches and seven eighths. The general height of the sides of the exostosis, from the basis of the face, was two inches; its walls were not thick, and terminated in a thin circular edge. The integuments, as they approached this edge, became thinner, and they extended over it into the cavity. The exostosis now reached to the nose in front, and to the masseter muscle behind; above it included the very ridge of the orbit, and below it grew from the edge of the alveolary process. A line, that would have separated the diseased from the sound bone, would have included the orbit and nose, and indeed one half of the face. Mr. Abernethy saw no means of affording the man relief. (*Trans. of a Society for the Improvement of Med. and Chir. Knowledge*, vol. ii.) See also a case related by Harrison. (*New Lond. Med. Journ.* vol. i. p. 1.)

In a case of fungus, which had distended the antrum, hindered the tears from passing down into the nose, raised the lower part of the orbit, caused a protrusion of the eye, made two of the grinding teeth fall out, and occasioned a carious opening in the front of the antrum, through which opening a piece of the fungus projected, Desault operated as follows: — The cheek was first detached from the os maxillare, by dividing the internal membrane of the mouth at the place where it is reflected over this bone. Thus the outer surface of the bone was denuded of all the soft parts. A sharp perforating instrument was applied to the middle of this surface, and an opening made more forward than the one already existing. The plate of bone situated between the two apertures was removed with a little falciform knife, which, being directed from behind forward, made the division without difficulty. The opening thus obtained being insufficient, Desault endeavoured to enlarge it below, by sacrificing the alveolary process. This he endeavoured to accomplish with the same instrument; but finding the resistance too great, he had recourse to a gouge and mallet. A considerable piece of the alveolary arch was thus detached, without any previous extraction of the corresponding teeth, three of which were removed by the same stroke. In this manner an opening was procured in the external and inferior part of the antrum, large enough to admit a walnut. Through this aperture a considerable part of the tumour was cut away with a knife, curved sideways, and fixed in its handle. A most profuse hemorrhage took place, but Desault, unalarmed, held a compress in the antrum for a short time; this being removed, the actual cautery was repeatedly applied to the rest of the fungus, and the cavity was filled with charpie dipped in powdered colophony.

On the eighteenth day, the swelling was evidently diminished, the eye less prominent, and the epiphora less visible. But, at this period, a portion of fungus made its appearance again. This was almost entirely destroyed by two applications of the actual cautery. It appeared again, however, on the twenty-fifth day, and required a third and last recourse to the cautery. From this time, the progress of the cure went on rapidly. Instead of fungous excrescences, healthy granulations were now formed in the bottom of the sinus. The parietes of the antrum gradually approaching each other, the large opening, made in the operation, was reduced to a small aperture, hardly capable of admitting a probe. Even this little opening closed in the fourth month, at which time no vestiges of the disease remained, except the loss of teeth, and a very obvious depression just where they were situated. (*Œuvres Chir. de Desault, par Bichat*, t. ii.; and *Parisian Chir. Journ.* vols. i. and ii.) See other cases recorded by Acoluthus (*Act. Cur. Natur.*); Garengeot (*Mém. de l'Acad. de Chir.*); Dupuytren (*Bulletins de la Faculté de Méd.*); Gensoul (*Sur quelques Mal. du Sinus Maxil.* p. 9.); Béclard (*Gensoul, Op.* cit. p. 11.); Georgi Gensoul (*Op. et loc.* cit.); Velpeau (*Ib.* p. 14.); Anderson (*Glasgow. Med. Journ.* vol. ii. p. 74.); Canolles (*Recueil Périodique de la Soc. de Méd.* t. ii. No. 9.); Eichorn (*Diss. de Polypis in Antro Highmori*, Goett. 1814); Sandifort (*Museum Anat.* vol. ii. tab. 30.); Leveillé (*Recueil de la Soc., &c.*, t. i. p. 24.); Weinhold (*Von den Rrankheiten der Geischtsknochen*, p. 27. 4to. Halle, 1818.)

In some of these examples, a cure is stated to have been accomplished; in others, the disease returned, and proved fatal. The question then arises, whether all the tumours were malignant, or only a part of them? Those which were permanently cured might have been of a different nature, not partaking of the character of medullary sarcoma, nor that of carcinoma.

With respect to Desault's operation, and any other performed for a medullary, or cancerous tumour of the antrum, it would have been desirable to know what was the state of the patient some considerable time after the removal of the swelling; for, as Sir Benjamin Brodie correctly observes, a malignant disease may appear to be cured for a twelvemonth, and yet return. The circumstance of Desault's patient seeming to be well four months after an operation of this kind, by no means proves that it produced a permanent cure. (See *Lond. Med. Gaz. for Dec.* 1834, p. 351.) Dr. Anderson, of Glasgow, has furnished information respecting the case, in which he extirpated a fungous tumour from the antrum after it had produced complete absorption of the bone. "This patient died of pectoral inflammation, *five years and a half afterwards*, when she had just recovered from the operation of removing nearly the whole of the *lower* jaw. On a minute examination of the antrum, the former disease was found to have been permanently cured by the operation." (*Anderson*, in *Lond. Med. Gaz. for Feb.* 1835.) Hence, Dr. Anderson disapproves of leaving a patient, even with such a tumour, to his fate.

Sir Benjamin Brodie formerly attempted to destroy a malignant tumour of the antrum in its early stage. The bone being absorbed, he cut out a large portion of the membrane, which now constituted the only boundary of the antrum. He now came to a considerable tumour, growing from a broad surface. "The outer part of the tumour, which was of soft consistence, I broke down with my fingers, and I then turned the tumour out, so that the antrum appeared to be perfectly empty. But this was not done without an enormous, and, indeed, frightful hemorrhage." Notwithstanding the free use of caustic and the actual cautery, the disease returned, and grew faster than it could be destroyed, and proved fatal. Mr. Liston's observations are to the same purpose. The malignant form of the disease, even in a very early stage, is pronounced by him to be unmanageable: "The tumours, if removed, are speedily reproduced, and the fatal termination may be accelerated by interference. I have removed tumours from the antrum maxillare, and from the frontal sinus; but the parts soon became occupied by morbid growths of a more formidable character than the preceding; the membrane and bone appear to assume a disposition to generate such disease; and the fungous protrusions cannot be kept down with escharotics, nor with the actual cautery. The antrum, when filled with such tumours, is easily laid open. The cheek is divided perpendicularly from over the inferior orbitar foramen to the mouth, and the soft parts are dissected from off the bone. The cavity may then be exposed by means of a small trephine; but this instrument is scarcely ever required, the parietes being so softened as to yield easily to the knife; though pliers, or cutting forceps, may be useful in enlarging the aperture. By the guidance of the finger, the attachments of the morbid growth are separated with a blunt-pointed bistoury; and a scoop is used to turn out the diseased mass. The root of the tumour is then touched with a red-hot iron; and by this implement, or by dossils of lint, the hemorrhage is easily arrested. But *such operations*, considering the result of those which have been practised, *are scarcely justifiable*." (See *Liston's Elem.* part ii. p. 158.)

Mr. Liston delivers the same judgment on the operation of removing a malignant tumour of the antrum, along with its investment, and every part of the bone to which it is connected. "The disease," says he, "is seldom, if ever, seen by the surgeon early enough to admit of any operation being practised with the least chance of ultimate success. At a sufficiently early period, the removal of the bone of the parietes of the cavity containing, and from which the tumour has grown, must, without doubt, afford a better chance, and is, in every point of view, to be preferred to the old operation of what was called trephining the antrum." The view which I now entertain of this subject, in relation to malignant tumours of the antrum, completely agrees with that taken by Sir Benjamin Brodie and Mr. Liston. If a case were needed to confirm the accuracy of their opinions, I would refer to that in which Mr. Guthrie lately operated in the Westminster Hospital, and who has honestly laid the true result of it before the public, as every other surgeon ought to do who ventures to try the practice. (See *Guthrie*, in *Lond. Med. Gaz. for January* 16. 1836.) The example in which M. Georgi operated, it seems, was followed by a lasting cure; but, as M. Gensoul remarks, there was a double piece of good luck in this instance; viz. that of a necrosis of the bone taking place to a sufficient depth to prevent the return of the disease, and the not less fortunate circumstance of such necrosis being restricted precisely to the half of the face. (See *Gensoul, Sur quelques Mal. graves du Sinus Maxil.* p. 19.) The case recorded in the *Bulletins de la Faculté de Méd.*, where Baron Dupuytren removed about one third of the alveolary arch and the bony palate, in order to extirpate an osteo-sarcoma, proved successful; but some forms of this disease are not regarded by British pathologists as partaking of the same degree of malignancy, the same unfavourable state of the constitution, and the same disposition to return, as attend medullary sarcoma and a truly cancerous swelling. The operations performed by Acoluthus, of Breslaw, and M. Garengeot, of Paris, are reported to have terminated in cures.

M. Gensoul, lately principal surgeon of the Hôtel Dieu at Lyons, instead of merely opening the antrum, cutting away as much of the tumour as possible, and attacking the rest with caustic or the cautery, proposed and practised another operation, founded on the same principles as are recognised by the best surgeons as applicable to every operation for the removal of a cancerous breast. "Here," says he, "all writers agree in advising amputation to be performed at the base of the disease, so as to make all the incisions in the sound parts; and this is exactly what I recommend to be done in diseases of the maxillary sinus." (*Sur Quelques Maladies Graves du Sinus Maxillaire*, p. 4.) Gensoul's first operation was executed on the 26th of May, 1827. (*Op.* cit. p. 18.) The precise date of Mr. Lizars' earliest operation I am not at the present moment acquainted with; but I suspect that this gentleman removed the whole antrum some time before a similar operation was practised by M. Gensoul; as, however, the particulars of Mr. Lizars' case are upon record, the question on this point may be settled without difficulty. This subject I shall have occasion to return to in another place, where a description of the operation of removing the antrum will be given. (See Bones, Excision of.)

As it appears from the foregoing observations that whatever operation is done, the patient has a fairer prospect of being cured by it when the disease does not partake of a medullary or cancerous nature, and as, likewise, the chances of recovery are so bad in the latter cases that many of the best surgeons pronounce any operation for them unjustifiable; it would be very desirable if the character of the disease could always be determined before the tumour has made its way beyond the limits of the antrum. I remember that Sir Benjamin Brodie once mentioned to me a case, in which he was able to ascertain the medullary consistence of the tumour by the introduction of one of his exploratory grooved needles. The plan seems to me one deserving of recollection. In the case here referred to, the antrum was removed by another surgeon, but the disease returned. In a case which was in the North London Hospital under my care, the disease, which was malignant, had caused ulceration of the cheek, and thrown out a firm fungous bleeding mass in that direction; so that the nature of the case was but too manifest. But if there had been no such protrusion of the disease through the cheek, the projecting part of the tumour in the roof of the mouth admitted of manual examination; and its consistence could be felt to be in some places elastic; in others, firm, like scirrhus, or mammary sarcoma. In fact, the preparation taken from the patient, an aged female, after her death, exemplifies a combination of these two structures; and is placed in the museum of the London University. Mr. Mayo, in noticing the importance of discriminating osteo-sarcoma from medullary sarcoma of the antrum, remarks, — "The only criterion that I am acquainted with for determining the nature of the swelling is to plunge a lancet into it; when, if the disease is osteo-sarcoma, the peculiar crisp sensation of cutting that texture will be perceived." (See *Mayo's Outlines of Pathology*, p. 278.)

A few years ago, Mr. Pattison suggested the expedient of tying the carotid artery, as likely to bring about the dispersion of fungous diseases of the antrum, without the necessity of meddling with the tumour itself. He adverts to three cases, the results of which, according to his account, were favourable to the practice. (See *Burns, On Anat. of the Head, &c. ed. by Pattison.*) However, the ligature of an arterial trunk has been tried by Sir Astley Cooper, to stop the progress of medullary tumours in other situations, but without success, (see *Surg. Essays*); and Mr. Liston declares, that the statement of a malignant tumour in the antrum having been arrested by ligature of the common carotid, is not borne out by facts. (*Elem. of Surgery*, part ii. p. 161.) In M. Magendie's *Journ. de Physiologie* is a case, in which this eminent physician tried in vain to stop the progress of a tumour of the antrum by tying the common carotid artery.

Insects in the Antrum.

It is said, that insects in this cavity may sometimes make it necessary for the surgeon to open it. This case, however, must be exceedingly rare; and even what we find in authors (*Pallas, De Insectis Viventibus intra viventia*) appears so little authentic, that I should hardly have mentioned the subject if there were not, in a modern work of repute (*Med. Comm.* vol. i.), a fact which appears entitled to attention. Mr. Heysham, a medical practitioner at Carlisle, relates, that a strong woman, aged sixty, in the habit of taking a great deal of snuff, was subject, for several years, to acute pains in the antrum, extending over one side of the head. These pains never entirely ceased, but were more severe in winter than summer, and were always subject to frequent periodical exacerbations. The patient had taken several anodyne medicines, and others, without benefit; and had twice undergone a course of mercury, by which her complaints had been increased. All her teeth on the affected side had been drawn. At length, it was determined to open the antrum with a large trochar, though there were no symptoms of an abscess, nor of any other disease in this cavity. For four days no benefit resulted from the operation. Bark injections, and the elixir of aloes, were introduced into the sinus. On the fifth day, a dead insect was extracted, by means of a pair of forceps, from the mouth of the cavity. It was more than an inch long, and thicker than a common quill. The patient now experienced relief for several hours: but the pains afterwards recurred with their former severity; oil was next injected into the antrum, and two other insects, similar to the former, were extracted. No others appeared, and the wound closed. The pains were not completely removed, but considerably diminished for several months, at the end of which time they became worse than ever, particularly affecting the situation of the frontal sinus.

Bordenave has published, in the twelfth and thirteenth volumes of the *Mém. de l'Acad. de Chir.* edit. 12mo., two excellent papers on diseases of the antrum. In the thirteenth volume he relates a case, in which several small whitish worms, together with a piece of fetid fungus, were discharged from the antrum, after an opening had been made on account of an abscess of this cavity, attended with caries. (P. 381.) But, in this instance, the worms had probably been generated after the opening had been made in the cavity; for when they made their appearance, the opening had existed nine months. Deschamps refers to another case, in which M. Fortassin, his colleague at La Charité, found in the antrum of a soldier, whom he was dissecting, a worm of the ascaris lumbricus kind, four inches in length. (*Traité des Mal. des Fosses Nasales, &c.* p. 107.) Such an example is also recorded in one of the volumes of the *Journ. de Méd.* Were a case of this description to present itself in a living subject, it would be advisable to inject oil into the cavity of the antrum, and then endeavour to wash out the extraneous substances, by throwing into the sinus warm water, by means of a syringe.

Bibl. and Refer.—Précis d' Observations sur les Maladies du Sinus Maxilliare, par *M. Bordenave*, in Mém. de l'Acad. Royale de Chir. t. xii. edit. in 12mo. Also, Suite d'Observations on the same subject, by *M. Bordenave*, t. xiii. of the said work; *L. H. Runge*, De Morbis Præcipuis Sinuum Ossis Frontis et Maxillæ Superioris, &c, Rintelii, 1750; *Haller*, Disp. Chir. 1. 205. *Jourdaine*, in Mém. de l'Acad. de Chir. t. iv. p. 357.: also Traité des Dépôts dans le Sinus Maxillaire, &c. 12mo. Paris, 1760; Traité des Mal. de la Bouche, t. ii. Paris, 1778; and Journ. de Méd. t. xxi. p. 57. et t. xxvii. p. 52—157. This author, who, in 1765, suggested to the Royal Academy of Surgery the method of injecting fluid into the antrum, through the natural opening, is said to have been anticipated in the practice by Allouel, who first conceived the plan in 1737, and tried it with success in 1739. See *Boyer*, Traité des Mal. Chir. t. vi. p. 149. *Becker*, Diss. de Insolito Maxillæ Superioris tumore aliisque ejusdem morbis, Wirceb. 1776. Remarques et Observations sur les Maladies du Sinus Maxillaire, in Œuvres Chir. de Desault, par *Bichat*, t. ii. p. 156. *Desault's* Parisian Chir. Journal, vols. i. and ii. Medical Communications vol. i. Trans. of a Soc. for the Improvement of Med. and Chir. Knowledge, vol. ii. Natural History of the Human Teeth, by *John Hunter*, p. 174, 175. edit. 3. *Gooche's* Chir. Works, vol. ii. p. 61, and vol. iii. p. 161. edit. 1792. *Callisen's* Systema Chirurgiæ Hodiernæ, t. i. p. 346. &c. *Dubois*, in Bulletin de la Faculté de Médecine, No. 8. *J. L. Deschamps*, Traité des Maladies des Fosses Nasales, et de leur Sinus, 8vo. Paris, 1804. *Eichorn*, Diss. de Polypis in Antro Highmori, Gött. 1804. *Liston*, Edin. Med. Journ. No. 68. *P. V. Leinicker*, De Sinu Maxillari, ejusdem Morbis, &c. Wirceb. 1809. *C. A. Weinhold*. Ideen über die abnormen Metamorphosen der Higmorshöle, Leipz. 1810. *C. A. Weinhold*, Von den Krankheiten der Gesichtsknochen und ihrer Schleimhaüte, der Ausrottung eines grossen Polypen in der linken Oberkieferhöhle, dem Verhuten der Einsinkens der Gichtischen und Venerischen Nase, und der Einsetzung Künstlicher Choanen, 4to. Halle, 1818. Account of a malignant Tumour removed from the Antrum, by *T. Irving*, in Edin. Med. Journ. Nos. 83. and 84. *J. Gensoul*, Lettre Chir. sur Quelques Maladies Graves du Sinus Maxillaire, et de l'Os Maxillaire Inférieur, 8vo. Paris, 1833, avec huit Planches, in folio. *Sir Benjamin C. Brodie*, Bart. in Lond. Med. Gaz. Dec. 1834. *G. J. Guthrie*, in Lond. Med. Gaz. *R. Liston*, in Elem. of Surgery, part ii.; and Med. Chir. Trans. vol. xx. *Scott*, in Lancet for 1831.

ANUS. The lower termination of the intestine, named the rectum, is so called, and its office is to form an outlet for the feces. It is furnished with muscles which are peculiar to it; viz, the sphincter, which keeps it habitually closed, and the *levator ani*, which serves to draw it up into its natural situation, after the expulsion of the feces. It is also surrounded, as well as the whole of the neighbouring intestine, with muscular fibres, and a very loose sort of cellular substance. As Cruveilhier observes, it is liable to a greater number of diseases than all the other natural openings together. In order that the loathsome affliction of a continual and involuntary discharge of the feces may not occur, the anus has for its base and support the sphincter, a voluntary muscle, which, as I have stated, keeps this opening habitually shut, and is antagonized when the necessity for emptying the rectum occurs, not only by the levator ani, its proper dilating muscle, but also by the diaphragm and muscles forming the anterior parietes of the abdomen. The want of something corresponding to a sphincter, is a main source of the annoyance resulting from an artificial anus. The external sphincter, as Cruveilhier further explains, is covered by skin, which is abundantly furnished with sebaceous follicles; hairs grow upon it, and it is folded on itself to assume the character of a mucous tissue. At the place of its duplicature it is thrown into many diverging wrinkles, which become effaced whenever the anus is dilated. In the situation where the skin is reflected, there is a great developement of erectile tissue. The common cuticle terminates a little above the reflexion, where, according to Cruveilhier, it is replaced by the kind of epidernius belonging to mucous textures. In the mucous membrane, are distributed the terminal ramifications of the hemorrhoidal arteries; while, from the erectile tissue, originate a multitude of tortuous plexiform veins, constituting the lowermost radicles of the vena portæ. The anus receives a large supply of nerves from the hypogastric plexus; and numerous mucous cryptæ lie under the mucous membrane, which their secretion serves at once to lubricate and to protect. (See *Cruveilhier*, in *Dict. de Méd. et de Chir. Pratiques*, t. iii. p. 113.)

Imperforate Anus.

As it is of the utmost consequence that this and other malformations should not remain long unknown, one of the earliest duties of an accoucheur, after delivery, is the examination of all the natural outlets of new-born infants.

The place in which the extremity of the rectum, or the anus, ought to be, may be entirely, or partly, shut up by a membrane, or fleshy adhesion. In other instances, no vestige of the intestine can be found, as the skin retains its natural colour over the whole space between the parts of generation and the os coccygis, without being more elevated in one place than another. In these cases, the intestines sometimes terminates in one or two culs-de-sac, about an inch upward from the ordinary situation of the anus. (See *Baillie's Engravings*, fasc. iv. tab. v.) Sometimes it does not descend lower than the upper part of the sacrum; sometimes it opens into the bladder, or vagina. Dr. Palmer dissected a case, where the colon, after reaching the vicinity of the left kidney, began, as it descended, to form a sigmoid flexure; but previously to its arrival at the concavity of the left ilium, made a sudden turn to the right, and, crossing the psoas muscle, reached the projection of the sacrum, where it terminated, *without entering the pelvis at all.* With this malformation was combined an imperforate meatus urinarius, and other considerable deviations of the genital organs from their natural structure. (See *Medico-Chir. Journ.* vol. i. 8vo. Lond. 1816.)

Sometimes the colon terminates in a sac, and the rectum is entirely deficient. (See *Beauregard*, in *Journ. de Méd.* i. 66.) Instances are also upon record, where the rectum opened into the urethra

(*Bresl. Samml.* 1718, p. 702.; *Hist. de l'Acad. Royale des Sciences*, 1752, p. 113.; *Hochstetter*, in *Med. Wochenblatt*, 1780, No. 18.; 1783, No. 19.; *Kretschmar*, in *Horn's Archiv.* b. i. p. 350.)

Cruveilhier saw an infant, in which the rectum opened under the glans penis, through a canal formed in the substance of the raphe of the scrotum. (*Anat. Pathol.* pl. vi. Ire livr.)

In cases of imperforate anus, if a speedy opening be not made for the feces, the infants soon perish, with symptoms similar to those of a strangulated hernia. Mr. A. C. Hutchinson thinks it advantageous, however, not to operate till the expiration of from twenty-four to sixty hours after birth, as he conceives that, within this period, no great inconvenience will arise, and the distension of the rectum with meconium will be a guidance to the surgeon in making the incisions. (See *Obs. in Surgery*, ed. 2.) After ascertaining the complaint, which is an easy matter, the surgeon should endeavour to learn, whether the anus is merely shut by portions of skin, a membrane, or a fleshy adhesion, or whether the anus is altogether wanting, in consequence of the lower portion of the cavity of the gut being obliterated, or the rectum not extending sufficiently far down.

When merely a thin production of the skin closes the opening of the rectum, the part producing the obstruction is somewhat different in colour from the neighbouring integuments, being usually of a bluish or livid hue, in consequence of the accumulation of the meconium under it. The meconium, propelled downward by the viscera above, forms a small roundish prominence, which yields like dough to the pressure of the fingers, but immediately projects again when the pressure is removed. When a fleshy adhesion closes the intestine, the circumstance is obvious to the eye, if the part protrude, as is generally the case; greater hardness and resistance are felt, than when there is merely a membrane; and the livid colour of the meconium cannot be seen through the obstructing substance.

These last circumstances are of themselves enough to convince the surgeon of the necessity of an operation; but they do not clearly show, whether the intestine descends as far as it ought, in order to form a proper kind of anus. Complete information on this point can only be acquired after the obstructing substance has been divided, or else after the child's death, when the operation has proved ineffectual. Though there be no mark to denote where the anus ought to be situated, and no degree of prominence, yielding, like soft dough, to the pressure of the fingers, and rising again when such pressure is removed; yet the rectum may still exist, and have a cavity, as far as the membrane, or adhesion, closing it.

When the anus is simply covered with skin, and its place indicated by a prominence, arising from the contents of the rectum, we have only to make an opening with a knife, sufficient to let out the meconium. Another cut may then be made across the first, and the four angles removed. About two years ago, I performed this operation on a child in a family near Bedford Square, attended by Mr. Wright, and the little patient was saved. A piece of bougie, or what is better, a portion of elastic gum catheter, is afterwards to be introduced, in order to keep the opening from closing. If the anus be only partly closed by a membrane, the opening may be dilated with tents or bougies; but, if the aperture be small, it is preferable to use the bistoury for its enlargement.

When no external appearance denotes where the situation of the anus ought to be, the case is more serious and embarrassing; and this, whether the intestine be stopped up by a fleshy adhesion, or the coalescence of its sides, or whether a part of the gut be wanting.

However, it is the surgeon's duty to do every thing in his power to afford relief. For this purpose, an incision an inch long, or rather more, is to be made in the situation where the anus ought to be, and the wound is to be carried more and more deeply in the natural direction of the rectum. The cuts are not to be made directly upwards, nor in the axis of the pelvis; for the vagina, or bladder, might thus be wounded. On the contrary, the operator should cut backward, along the centre of the concavity of the os coccygis, where there is no danger of wounding any part of importance. In all cases of this kind, the surgeon's finger is the best director. The operator, guided by the index finger of his left hand, introduced within the os coccygis, is to dissect in the direction above recommended, until he reaches the feces, or has cut as far as he can safely reach with his finger. If he should fail in finding the meconium, as death must unavoidably follow, one more attempt ought to be made, by introducing, upon the finger, a middle-sized trocar, in the direction best calculated to reach the rectum, without danger to other parts, viz. upwards and backwards in the median line. The cannula may be left in the puncture, and secured there with tapes, so as to afford an outlet for the feces. In some observations on this subject, addressed to the Medical and Chirurgical Society by Mr. A. Copland Hutchison, he recommends an elastic gum catheter to be substituted for the cannula, after a week; and, when the tube can be dispensed with, a sponge tent, or piece of bougie, to be worn twelve out of the twenty-four hours. (See *Obs. in Surgery*, ed. 2. 1826.)

In an interesting case, recorded in Langenbeck's new Surgical Bibliotheca, the imperforate state of the anus was not discovered till the evening of the 12th day from the child's birth, when hiccough and convulsions had come on. M. Wolff found the abdomen protuberant, hard, and painful when handled, and the child was suffering from nausea, vomiting, and great depression of strength. Next day, he introduced a lancet a few lines in front of the os coccygis, to the depth of an inch, without finding the rectum. The puncture was then carried to the depth of two inches, but without effect. With a pharyngotomus, however, he now succeeded in piercing the rectum; and a glyster was administered, which brought away some meconium. Under the use of glysters and tents, the child soon recovered.

By such proceedings, many infants have been preserved, which would otherwise have been devoted to certain death. Hildanus, La Motte, Roonhuysen, Mr. A. Copland Hutchison, and others, have successfully adopted the practice. Mr. B. Bell met with two cases, in which the intestine was very distant from the integuments, yet he succeeded in forming an anus, which fulfilled its office tolerably well for several years; though he found it difficult to keep it pervious. As soon as he removed the dossils of lint, and other kinds of tents, used for maintaining the necessary dilatation, such a degree of contraction speedily followed, that the evacuation of the intestinal matter became difficult. He employed, at different times, tents made of sponge, gentian root, and other substances, which swell on being moistened. But they always produced such pain and irritation, that it was impossible to persevere in their use. Tents of soft lint dipped in oil, or rolls of bougie-plaster, were found to cause less irritation, than those composed of any other materials.

Though keeping the opening dilated may seem simple and easy to such men as have had no opportunities of seeing cases of this description, it is far otherwise in practice. Mr. B. Bell assures us, that he never met with any disease, that gave him so much trouble and embarrassment, as he experienced in the two cases of this sort, which occurred in his practice. Although, in both instances, he made the openings at first sufficiently large, it was only by very assiduous attention for eight or ten months, that the necessity for another operation, and even repeated operations, was prevented. When only the skin has been divided, the rest of the treatment is, doubtless, more simple; for, then, nothing more is requisite, than keeping a piece of lint, for a few days, in the opening made with the knife. But, when the extremity of the rectum is at a certain distance, though we may generally hope to effect a cure, after having succeeded in giving vent to the intestinal matter; yet the treatment, after the operation, will always demand, for a long while, a great deal of attention and care on the part of the surgeon. In a highly interesting example, recorded by Mr. Miller, of Methven, such was the tendency to closure of the new opening, that he was obliged to repeat the operation ten times before the child was eight months old. (See *Edin. Med. Journ.* No. 98. p. 62.) Notwithstanding all these operations, and another one of two hours and three quarters' duration, performed several years afterwards for the extraction of an alvine concretion, equal in size to a turkey's egg, the power of the sphincter was perfect. The difficulty of success may be considered as, in some measure, proportioned to the depth of the necessary incision. An infant was brought to the North London Hospital with an imperforate anus; Mr. Liston, after carrying the incisions to the depth of three inches, made a small opening into the intestinal canal, as indicated by the discharge of fetid gas, and a small quantity of meconium. A piece of bougie was introduced to maintain the opening; but the child died in a very short time, and there was no opportunity of ascertaining the state of the parts. In a case like that recorded by Dr. Palmer, to which I have above adverted, the inutility of any attempt to discharge the feces by an operation, in the usual site of the anus, must be sufficiently obvious. (*Medico-Chir. Journ.* vol. i. p. 181.)

Sometimes, while the anus appears pervious and well formed, the infant suffers the same symptoms as if there were no anus at all. The reason of this depends upon the intestine being occasionally closed by a membranous partition, situated more or less upward, above the aperture of the anus. (*Courtial, Nouvelles Obs. sur les Os*, p. 147.; *John Wayte*, in *Edin. Med. and Surgical Journ. April*, 1821.; and *Cases in Hutchison's Obs. in Surgery*, ed. 2.); and sometimes the symptoms are owing not simply to an interruption of the cavity of the intestine, but even of its parietes; and thus the colon may be separated entirely from the rectum. (*Andral. Précis, d'Anat. Pathol.* t. ii. p. 143.) Such erroneous formations may be suspected, when an infant, whose anus is externally open, does not void any excrement for two or three days after its birth, and especially when urgent symptoms arise, such as swelling of the belly, vomiting, &c. We are now to endeavour to ascertain, whether the rectum is impervious above the anus, by attempting to inject glysters, or introducing a probe. If the gut be shut up, there is nothing to be done but having recourse to the method described above, and forming a communication by means of a bistoury guided on the finger, or else with a pharyngotomus. If the obstacle should only consist of a transverse membrane, the operation will be easy, and its success highly probable; but if there should be an internal strangulation, or obstruction of the intestinal canal, from total deficiency of some part of its parietes, the case is infinitely more serious.

In the case recorded by Mr. Wayte, the membranous septum was felt by the finger, about an inch from the verge of the anus. It was pierced with a pointed probe, which was followed by a hydrocele trocar, and afterwards by a bougie of larger dimensions. On withdrawing the latter, much meconium, mixed with feces, escaped, and continued to be frequently discharged. In a week, however, the opening closed, and a fresh puncture was made, which was maintained by the frequent introduction of bougies. The child proceeded tolerably well until the end of another week, when the passage was again much contracted, and the abdomen proportionably distended. On the 20th day from birth, a full-sized trocar was used for restoring the opening, which, however, again had a tendency to close, but was afterwards dilated by introducing twice a day bougies, which were increased in size, until a rectum bougie of middling size could be passed. The boy now rapidly improved, and every hope of a perfect recovery was entertained, but disease of the os coccygis ensued; and, at the end of six months, the little patient died hectic. (See *Edin. Med. and Surg. Journ.* vol. xvii.)

When the anus is imperforate, the intestine sometimes opens into the vagina, or bladder, or urethra; there being, as Andral expresses himself, a tendency in the terminal orifices of the digestive, urinary and genital organs to be confounded together, and to form a common cavity more or less analogous to the cloacæ of birds. (*Précis d'Anat. Pathol.* t. ii. p. 144.; *Dumas*, in *Recueil Périodique de la Soc. de Méd.* t. iii. No. 13.; *L'Eveillé, Rapport des Travaux de la Soc. Philom.* vol. i. p. 145.; *Murray. Diss. Atresi Ani vesicalis*, Ups. 1794.; *Act. Nat. Cur.* vol. viii. Obs. 24.; vol. ix. Obs. 11.; *Rcestel*, in *Mursinna's Journ. für die Chir.* b. i. p. 547.; *Obs. Med.* Decad. ii. No. 2.; *Velpeau, Nouv. Elém.* t. iii. p. 977.) The first case is the least dangerous of such malformations. The intestine may also terminate at two places at the same time, viz. at the usual place, so as to form a proper anus, more or less perfect; and also in the vagina. If the rectum were to terminate at the lower and posterior part of the vulva of which, M. Brachet has lately published an example, the making of a new anus in the proper situation would be unattended with difficulty. A director should be passed into the rectum through the opening already existing, and an incision made, under the guidance of this instrument, from the perineum towards the coccyx, through all the textures, keeping up the displacement of the end of the rectum. A cannula is then to be fixed in the bowel, at the posterior part of the wound, by which means the front of the incision would have an opportunity of healing, and the feces take their right course. This operation was recommended by Vicq. d'Azyr. M. Velpeau sees no occasion for the suture, advised by M. Martin for the union of the anterior part of the wound, and suggests, that sometimes it may be advantageous not to divide the recto-vaginal septum at all, but to pass a blunt curved instrument from the vaginal fistula to the lower end of the bowel, and then make a puncture into the latter through the skin. (See *Velpeau Nouv. Elém. de Méd. Opér.* t. iii. p. 979.)

When the two openings are exceedingly small, and the feces cannot readily pass out, even with the aid of glysters, the opening of the anus ought to be enlarged with a knife, and kept dilated with a cannula. The communication with the vagina will then gradually close.

For the most part, the intestine has but one opening in the vagina. In this circumstance, the surgeon should make an incision in the place which the anus ought to occupy. The natural course of the feces being thus opened, less excrement will pass out of the vagina; and by the introduction of a tube into the new anus, the communication between the rectum and vagina will be obliterated, and a perfect cure accomplished; an instance of which is recorded by M. Lépine. (See *Dict. de Méd. et de Chir. Prat.* t. iii. p. 121.) The opening between the intestine and vagina is sometimes too small for the due evacuation of the feces, and the infant is then exposed to the same sort of dangerous symptoms as if the rectum had no opening at all.

In male infants, the rectum sometimes opens into the bladder; and, in this circumstance, there is generally no anus. The case is easily known, by the meconium being blended with the urine, which acquires a thick greenish appearance, and is voided almost continually, though in small quantities. Only the most fluid part of the meconium is thus discharged. The thicker part, not getting from the rectum into the bladder, nor from the bladder into the urethra, greatly distends the intestines and irritates the bladder, producing in the end fatal symptoms. For a few days, however, the meconium may be diluted, and voided with the urine. An infant, whose meconium came away through the urethra, seen by M. Velpeau, lived nearly a week. (*Nouv. Elém de Méd. Opér.* t. iii. p. 977.) In all such cases one thing is certain, viz. that without the speedy interference of art to form an anus, capable of serving as an outlet to the feces, with which the urinary organs cannot remain obstructed, the infant will inevitably die. This case must, therefore, be treated on the same principles, which apply to the foregoing examples. Though we can hardly hope to prevent altogether the inconveniences resulting from the rectum opening into the bladder, since even a new passage will not completely hinder the feces from following the other course; yet we shall thus afford the child the only chance of preservation which its situation will allow.

In cases, in which an outlet for the feces cannot be procured by any of the methods pointed out above, Littre proposed, in 1720, to make an opening in the sigmoid flexure of the colon, above the left groin, and thus form an artificial anus. In 1788, Dumas tried the plan on an infant, which died on the tenth day. In 1793, it was practised with complete success by M. Duret, of Brest; and M. Pilore, of Rouen, had an equally fortunate case. But the infant, on whom Desault operated in 1794, lived but four days afterwards. M. Ouvrard, of Anger, and M. Roux, of Paris, lost also the two children on whom they made the experiment. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. iii. p. 983.) M. Duret cut into the abdomen at the lower part of the left iliac region: and, having opened the sigmoid flexure of the colon, he fixed it near the wound. The child was saved by the formation of an artificial anus; but at the age of twenty-five months, it continued to be troubled with a prolapsus of the lining of the bowel. (See *Recueil Périodique de la Soc. de Méd.* t. iv. No. 19.; and *Sabatier Méd. Opératoire,* t. iii. p. 336. edit. 2.)

An instance was published by Mr. Pring, in which he made an opening in the colon, near its sigmoid flexure, in a lady, who, in consequence of a scirrhous disease of the rectum, was afflicted with an obstinate and perilous obstruction of the intestinal canal. The patient survived the operation nearly sixteen months, at the end of which time she fell a victim to the disease of the rectum. (See *London Med. and Physical Journal,* vols. xlv. and xlvii.) Every permanent closure or obliteration of a part of the intestinal canal being fatal if left to itself, M. Velpeau sees nothing blameable in forming, in such a case, an artificial anus. The difficulty, says he, would first be to acquire a certainty of the existence of the obliteration or permanent closure, and then to ascertain that it was situated in the rectum, or lower part of the sigmoid flexure of the colon, so that the artificial anus above Poupart's ligament would be above the obstruction. These points, however, according to M. Velpeau, are often made out. "Braillet had no doubt about them in the case which he has recorded. Neither was M. Solon mistaken in the example quoted by M. Paris. The same things were equally manifest in the course of Talma's disease. I may apply a similar remark to the case of a woman, whose body I examined in 1825. No modification of the operation would be requisite, except that, instead of being always performed on the left side, it might be indispensable to cut into the right iliac fossa, if the stricture were in the transverse or ascending colon. After all (observes M. Velpeau), this operation is not merely a theoretical speculation: practitioners have had the courage to perform it on the living subject. Martland, who first did this in 1814, saved his patient's life." (See *Nouv. Elém. de Méd. Opér.* t. iii. p. 985.) I should be reluctant to offer any remarks encouraging the repetition of this practice, against which various considerations present themselves, particularly in cases where, besides a mere difficulty of emptying the bowels, another disease exists, which is itself likely to destroy the patient, and is of a nature not capable of receiving any effectual benefit from the operation.

The operation consists in making an incision a little above Poupart's ligament, about two inches in length, and on the outer side of the course of the epigastric artery; the skin, superficial fascia aponeurosis of the external oblique muscle, the lower fibres of the internal oblique and transverse muscles, the fascia transversalis, and the peritoneum, are to be divided in succession. As soon as the peritoneum has had a small puncture cautiously made in it, a director is to be introduced into the opening, which is to be enlarged with a probe-pointed bistoury. The distended bowel, of a livid or greenish colour, presents itself in the wound; and, being opened in the same direction as the wound, a tent, or a piece of full-sized elastic gum catheter, should be placed in the new passage. The introduction of a ligature through the mesentery is sometimes advised; but as my observations only refer to opening the sigmoid flexure of the colon, such expedient is out of the question.

Callisen conceived, that the descending colon might be most safely got at by making an incision in the left lumbar region, along the edge of the quadratus lumborum muscle, and opening that intestine between the two layers of peritoneum, which fix it in its situation. Thus he calculated that all necessity for cutting into the cavity of the peritoneum itself would be obviated. (*Syst. Chir. Hodiernæ*, t. ii. p. 688, 689. ed. 1800.) The operation was tried in one case by M. Roux, but in two hours the infant perished. (See *Velpeau, Nouv. Elém. de Méd. Opér*. t. iii. p. 984.) I fully agree with the latter surgeon, that this method, which is far more difficult than the plan of M. Littre, must be fully as dangerous.

I shall conclude this subject with briefly mentioning a scheme, attributed to M. Dubois, which was, to introduce some exploratory instrument into the intestinal canal, through the wound above Poupart's ligament, for the purpose of ascertaining whether it is practicable to push it on to the perineum, and, with its assistance, to form an anus in the natural place. This, as M. Velpeau informs us, has hitherto only been attempted on the dead body.

See *Sabatier*, Médecine Opératoire, t. iii. p. 330. *Pappendorf*, De Ano infantum imperforato, Leipz. 1783. Remarques sur Différens Vices de Conformation que les Enfans apportent en naissant, par M. Petit, in Mem. de l'Acad. Royale de Chir. t. ii. p. 236. edit. in 12mo. *H. A. Wrisberg*, De præternaturali et raro Intestini Recti cum vesica urinaria coalitu, et independente Ani defectu, 4to. Gött. 1779. *Ford*, in Med. Facts and Obs. vol. i. No. 10. *Chamberlaine*, in Memoirs of the Med. Soc. of Lond. vol. v. No. 23. *Richerand*, Nosographie Chir. t. iii. p. 437. &c. edit. 4. *G. Wayte*, in Edin. Med. Journ. vol. xvii. Lancet, vol. i. p. 434. *A. C. Hutchison*, in Pract. Obs. in Surgery, ed. 2. 1826. *Miller*, in Edin. Med. Journ. No. 98. p. 61. *Jolliet*, in Journ. de Méd. par Leroux, t. xxxii. p. 272. *Alf. L. M. Velpeau*, Nouv. Elém. de Méd. Opér. t. iii. p. 977. 8vo. Paris, 1832.

Abscesses of the Anus.—Fistula in Ano.

The custom of giving the appellation of *fistula* to every collection of matter formed near the anus, has frequently, by conveying a false notion of them, been productive of such methods of treatment, as are diametrically opposite to those which ought to be pursued. It is well observed by Pott, that a small orifice or outlet from a large or deep cavity, discharging a thin gleet or sanies, made a considerable part of the idea, which our ancestors had of a fistulous sore, wherever seated. With the term fistulous, they always connected a notion of callosity; and therefore, whenever they found such a kind of opening yielding such sort of discharge, and attended with any degree of induration, they called the complaint a *fistula*. Imagining this callosity to be a diseased alteration made in the very structure of the parts, they had no conception, that it could be cured by any means but by removal with a cutting instrument, or by destruction with escharotics; and, therefore, they immediately attacked it with knife or caustic, in order to accomplish one of these ends.

Collections of matter from inflammation (wherever formed), if they be not opened in time, and in a proper manner, do often burst. The hole, through which the matter finds vent, is generally small, and not often situated in the most convenient or most dependent part of the tumour: it therefore is unfit for the discharge of all the contents of the abscess; and, instead of closing, contracts itself to a smaller size, and, becoming hard at its edges, continues to drain off what is furnished by the sides of the cavity.

When an abscess near the anus bursts, the smallness of the accidental orifice; the hardness of its edges; its being found to be the outlet from a deep cavity; the daily discharge of a thin, gleety, discoloured kind of matter; and the induration of the parts round about, have all contributed to raise and confirm the idea of a true fistula.

Abscesses about the anus present themselves in different forms.

Sometimes the attack is made with symptoms of high inflammation; with pain, fever, rigor, &c. and the fever ends as soon as the abscess is formed. In this case a part of the buttock, near the anus, is considerably swollen, and has a large circumscribed hardness. In a short time, the middle of this hardness becomes red and inflamed, and in the centre of it matter is formed.

The pain is sometimes great, the fever high, the tumour large, and exquisitely tender; but however disagreeable the appearances may have been, or however high the symptoms may have risen, before suppuration, yet, when that end is fairly and fully accomplished, the patient generally becomes easy and cool; and the matter formed under such circumstances, though it may be plentiful, is good.

On the other hand, the external parts, after much pain, attended with fever, sickness, &c. are sometimes attacked with considerable inflammation, but without any of that circumscribed hardness which characterises the preceding tumour; instead of which the inflammation is extended largely, and the skin wears an erysipelatous kind of appearance. In this the disease is more superficial, the quantity of matter small, and the cellular membrane sloughy to a considerable extent.

Sometimes, instead of either of the preceding appearances, a grangrenous suppuration takes place, and the cellular tissue is affected in the same manner as it is in a carbuncle.

In this case, the skin is of a dusky red or purple kind of colour; and, although harder than in a natural state, it has, by no means, that degree of tension or resistance, which it has either in phlegmon, or in erysipelas. The patient has generally, at first, a hard, full, jarring pulse, with great thirst and restlessness. If the progress of the disease be not stopped, or the patient relieved by medicine the pulse soon changes into an unequal, low, faltering one; and the strength and the spirits sink in such manner, as to imply great and immediately impending mischief. The matter formed under the skin, so altered, is small in quantity, and bad in quality, and the adipose membrane is gangrenous and sloughy throughout the extent of the discoloration.

Sometimes the disease makes its first appearance in the induration of the skin, near to the verge of the anus, but without pain or alteration of colour; which hardness gradually softens and suppurates. The matter, when let out in this case, is small in quantity, good in quality; and the sore is superficial, clean, and well-conditioned. On the contrary, it now and then happens, that although the pain is but little, and the inflammation apparently slight, yet the matter is large in quantity, bad in quality, extremely offensive, and proceeds from a deep crude hollow. (*Pott.*)

Sir Benjamin Brodie remembers a gentleman, in whom an abscess formed by the side of the rectum, and who was not conscious of any local symptoms; " but he had been for some time subject to headach, was languid, forced to go home, and lie down in the middle of the day. One day, as he was walking in the streets, the abscess burst, and that was the first thing which gave him any notice of its existence." (See *Lond. Med. Gaz.* for 1835, 1836, p. 26.)

The place where the abscess points, and where the matter, if let alone, would burst its way out, is various and uncertain. Sometimes, it is in the buttock, at a distance from the anus; at other times near its verge, or in the perineum; and this discharge is made sometimes from one orifice only, sometimes from several. In some cases there is not only an opening through the skin, externally, but another through the intestine into its cavity; in others, there is only one orifice, and that either external or internal.

Sometimes the matter is formed at a considerable distance from the rectum, which is not even laid bare by it; at others, it is laid bare also, and not perforated: it is also sometimes not only denuded, but pierced; and that in more places than one.

All consideration of preventing suppuration is generally out of the question: and our business, if called at the beginning, must be to moderate the symptoms; to forward the suppuration; when the matter is formed, to let it out; and to treat the sore in such a manner as shall be most likely to produce a speedy and lasting cure.

When no symptoms require particular attention, and all that we have to do is to assist the maturation of the tumour, a soft poultice is the best application. When the disease was of the phlegmonous kind, Mr. Pott preferred letting the skin become very thin before an opening was made in it; but, at the present day, abscesses near the anus and rectum are commonly opened directly the matter has formed. This kind of tumour is generally found in people of full sanguine habits: and who, therefore, if the pain be great, and the fever high, will bear evacuation, both by phlebotomy and gentle cathartics.

When the inflammation is erysipelatous, the quantity of matter formed is small, compared with the size and extent of the tumour; the disease is rather a sloughy, putrid state of the cellular membrane, than a single abscess, and, therefore, the sooner it is opened the better: if we wait for the matter to make a point, we shall wait for what will not happen; at least not till after a considerable length of time, during which the disease will extend itself.

When, instead of either of the preceding appearances, the skin wears a dusky purplish-red colour; has a doughy, unresisting kind of feel, and very little sensibility: when these circumstances are joined with an unequal faltering kind of pulse, irregular shiverings, a great failure of strength and spirits, and inclination to dose, the case is formidable, and the event generally fatal.

The habit, in these circumstances, is always bad; sometimes from nature, but much more frequently from gluttony and intemperance. What assistance art can lend, must be administered speedily; every minute is of consequence; and if the disease be not stopped, the patient will sink. Here (says Pott) is no need for evacuation of any kind: recourse must be immediately had to medical assistance; the part affected should be frequently fomented; a large and deep incision should be made into the diseased part, and the applications made to it should be of the warmest, most antiseptic kind.

Strangury, dysury, and even total retention of urine, are no very uncommon attendants upon abscesses in the neighbourhood of the rectum and bladder: more especially if the seat of them be near the neck of the latter organ. They sometimes continue from the first attack of the inflammation until the matter is formed, and has made its way outward, and sometimes last a few hours only.

The two former most commonly are easily relieved by the loss of blood and the use of gum arabic, with nitre, &c. But in the total retention, they who have not often seen this case generally have immediate recourse to the catheter; but this practice was condemned by Pott, who observes that the retention here is spasmodic, and arises from irritation, notwithstanding the participation of the neck of the bladder in some degree, in the inflammation.

The following is the practice advised by Pott: — Loss of blood is necessary, the quantity to be determined by the strength and state of the patient; a gentle cathartic: but the most effectual means of relief seemed to him to be the warm bath, or semicupium; the application of bladders with hot water to the pubes and perineum; and, above all other remedies, the injection of a glyster, consisting of warm water, oil, and opium.

A painful tenesmus is no uncommon attendant upon an inflammation of the parts about the rectum. If a dose of rhubarb, joined with the confect. opii, does not remove it, the injection of thin starch and opium, or tinct. thebaic., is almost infallible.

The bearing down in females, as it proceeds, in this case, from the same kind of cause (viz. irritation), admits of relief from the same means as the tenesmus.

In some habits, an obstinate costiveness attends this kind of inflammation, accompanied, not unfrequently, with a painful distention and enlargement of the hemorrhoidal vessels, both internally and externally. While a large quantity of hard feces is detained within the large intestines, the whole habit must be disordered; and the symptomatic fever, which necessarily accompanies the formation of matter, must be considerably heightened. And while the vessels surrounding the rectum (which are large and numerous) are distended, all the ills proceeding from pressure, inflammation, and irritation, must be increased. Here we must agree with Pott, that phlebotomy, laxative glysters, and a low cool regimen must be the remedies: while a soft cataplasm, applied externally, will serve to relax and mollify the swollen indurated piles, at the same time that it hastens the suppuration.

When abscesses have formed, and are fit to be opened, or when they have already burst, they may be reduced to two general heads, — viz.

1. Those, in which the intestine is not at all interested: and

2. Those, in which it is either laid bare, or perforated.

In making the opening, the knife or lancet should be passed in deep enough to reach the fluid; and when it is in, the incision should be continued upward and downward, in such manner as to divide all the skin covering the matter. By these means, the contents of the abscess will be discharged at once; future lodgment of matter will be prevented, and convenient room will be made for the dressings.

Notwithstanding all these collections of matter are generally called *fistulæ*, and are all supposed to affect the rectum, the abscess is sometimes really at a distance from the gut, and none of these cases either are or can be originally *fistulæ*. (*Pott.*)

Abscesses near the rectum happen with particular frequency in persons who are habitually costive, and, according to Sir Benjamin Brodie, in those also who have been troubled with piles. His observations confirm the truth of some cases on record, where abscesses of the rectum are stated to have been produced by foreign bodies penetrating through the mucous membrane of the bowel and sphincter muscle, into the cellular tissue. "I was sent for (he informs us) to a gentleman, who had a very uneasy feeling in the rectum. I thought he laboured under internal piles, and prescribed for him something, which, however, did not relieve him. The next day, as he was no better, I examined the rectum, and found a hard substance sticking in the mucous membrane: with some difficulty I extracted it, and found it to be part of the core of an apple, which the patient had eaten." If this had not been extracted, no doubt an abscess might have been produced by the side of the gut. Sir Benjamin Brodie was sent for to another patient, who had an abscess near the rectum; and, after he had opened it, he detected a long fish-bone sticking across it, which was extracted. The bone had evidently penetrated the mucous membrane of the bowel; and, in all probability, some feculent matter had passed by the side of it, so as to account for the remarkable putridity of the matter. (See *Lond. Med. Gaz.* for 1835, 1836, p. 27.) The experience of Sir Benjamin Brodie likewise agrees with the remark made by the greater number of writers on this subject, respecting the occasional formation of abscesses near the rectum in persons otherwise healthy, though they take place far more commonly in unhealthy individuals.

A few years ago, some interesting remarks on fistula in ano were published in France by M. Ribes, deduced from the dissection of not less than seventy-five persons, who had died with fistulæ. No man, who has seen much of this part of surgery, can doubt that the most frequent form of the disease is that, in which the abscess has only an external opening, and does not perforate the rectum at all, from which, indeed, the matter is sometimes more or less distant. Nor can any experienced surgeon question the truth of Mr. Pott's account, respecting the diversity of the nature of the cases of fistulæ, some being phlegmonous, some erysipelatous, and others more like the carbuncle in their origin, progress, and consequences. But, besides these circumstances, another one worthy of notice is, that the presence of fistula in ano by no means always implies the previous or present existence of piles. However, notwithstanding these considerations, the doctrine started by M. Ribes is, that a fistula is formed by the bursting of an internal pile into the rectum, and the consequent passage of a portion of the contents of the bowel into the orifice. Now this is not the common mode in which an abscess near the anus is occasioned; yet it sometimes appears, as an exception to the common course of things. Sir Benjamin Brodie speaks of two kinds of abscesses as happening in connection with piles. First, an abscess may form in an external pile, and burst externally. Sometimes, says he, it will heal, and not form again; at other times, it will heal, and then form again. Secondly, an abscess may form in internal piles, which burst into the cavity of the rectum; and this sometimes heals spontaneously, and sometimes not. (*Brodie*, in *Lond. Med. Gaz. for Oct.* 1835, p. 26.) According to M. Ribes, the orifice is *always* within five or six lines above the junction of the internal membrane of the bowel with the external skin, and may usually be seen if the patient forces the gut gently down, as in going to stool. This account of the common situation of the internal opening, when the abscess communicates with the bowel, agrees with the observations of Sabatier, Larrey, and Chelius. (See *Recherches sur la Situation de l'Orifice interne de la Fistule de l'Anus. &c. Quarterly Journ. of Foreign Med.* No. 8. *Oct.* 1820; *Larrey*, in *Mém. de Chir. Mil.* t. iii. p. 415.: *Chelius, Handb. der Chir.* b. i. p. 577. 8vo. Heidelb. 1826.)

If a large and convenient opening has been made by a simple incision, the contents of the abscess have been discharged, and a cavity left, which is to be filled up, the dressings ought to be so small in quantity as to permit nature to bring the sides of the cavity towards each other, and they ought not by their quality either to irritate or destroy.

In this, as in most other cases, where there are large sores or considerable cavities, a great deal will depend on the patient's habit, and the care that is taken of it; if that be good, or if it be properly corrected, the surgeon will have very little trouble in his choice of dressings; only to take care that they do not offend either in quantity, or quality: but if the habit be bad, or injudiciously treated, he may (according to Pott's expression) use the whole farrago of externals, and only waste his own and his patient's time.

By light easy treatment, large abscesses formed in the neighbourhood of the rectum will sometimes be cured, without any necessity for meddling with the bowel. But more frequently the intestine, although it may not have been pierced by the matter, has yet been so denuded that no consolidation of the sinus can be obtained but by a division; that is, by laying the two cavities, viz. that of the abscess, and that of the intestine, into one.

Sir Benjamin Brodie admits, with Pott, that abscesses near the rectum, after discharging themselves, sometimes heal up like others. This, however, he considers as an exception to a general rule. In the majority of examples, if nothing be done, the opening will continue, sometimes discharging little and sometimes much; or it will alternately close and break. Sir Benjamin Brodie has seen several cases (and most other surgeons of experience must have seen the same thing) where a neglected fistula has continued in this state for years. This, however, is what ought not to be allowed; for, sooner or later, the case may assume a formidable character. The following case is related by this eminent surgeon: — A gentleman had had an abscess by the side of the rectum for twenty years, sometimes discharging a little matter, then stopping, and afterwards discharging again. Three or four months before Sir Benjamin Brodie was consulted the orifice closed, and did not open again as usual; after this the patient soon began to suffer a great deal of pain, and became exceedingly ill. Sir Benjamin Brodie examined the rectum, and satisfied himself of the existence of a very large deep abscess; a lancet was introduced by the side of the gut, and it went in quite up to the handle before the matter was reached. When a little matter had escaped, a director was introduced, and the opening freely dilated with a probe-pointed bistoury; a pint or more of very putrid matter immediately flowed out. Afterwards another enlargement of the wound became necessary, and the patient recovered from a dangerous state, produced entirely by the neglect of a trifling case. (*Op.* et vol. cit. p. 28.) The reason of abscesses near the rectum less frequently healing up than others, is referred by Sir Benjamin Brodie to the sinus, or passage for the matter, running through the sphincter muscle. "The sphincter muscle is constantly in motion, contracting and dilating, and consequently there is not the repose which is necessary for the cure of the abscess." (*Op.* et. vol. cit. p. 27.) Sir Benjamin Brodie acknowledges, that an abscess sometimes forms high up by the side of the rectum, above the sphincter; but this he regards as an occurrence comparatively rare. "These abscesses (he observes) attain a very large size before the patient suffers much pain or inconvenience. There is at first merely a sense of bearing down of the rectum, occasioned by the pressure of the abscess on it; but as the abscess increases in size, the patient has violent painful spasms, and a constant feeling as if he wanted to pass a motion, while there are no feces in the bowel. His sufferings are now excessive. You examine the external parts, and you see nothing; you introduce your finger into the rectum, and there you perceive the abscess pressing on one side of the gut, and very much diminishing its diameter. Having thus ascertained the position of the abscess, if you examine the external parts again, although you could discover nothing in the first instance, you will probably be able to detect it, deep seated as it is, at the side of the anus. More resistance will be offered to the pressure of the finger here than elsewhere; and if you introduce two fingers of the left hand into the rectum, and press on the abscess from within, you will make it actually bulge a little externally." Sir Benjamin Brodie then proceeds to explain, that abscesses, formed high up by the side of the rectum, if left to themselves, generally burst into it.

When the intestine is found to be separated from the surrounding parts by the matter, the operation of dividing it should be performed at the time the abscess is first opened, and not be deferred. For, if it be done properly, it will add so little to the pain which the patient must feel by opening the abscess, that he will seldom be able to distinguish the one from the other, either with regard to time or sensation; whereas, if it be deferred, he must either be in continual expectation of a second cutting, or feel one at a time when he does not expect it.

The intention in this operation is to divide the intestine, from the verge of the anus, up as high as the top of the hollow in which the matter was formed; thereby to lay the two cavities of the gut and abscess into one, and by means of an open wound, instead of a hollow or sinuous sore, which serves for the lodgment of matter, to obtain a firm and lasting cure. The operation, however, is effectual partly on another principle, first particularly explained by Sir Benjamin Brodie. The division of the sphincter muscle had indeed been insisted upon by others (see *Chelius Handb. der Chir.* b. i.); but the principle of its utility had not been duly pointed out. "When the abscess is laid open, the fibres between it and the bowel must be divided; and the sphincter muscle being thus set at liberty, not only is there a free and ready escape for the matter, but the action of the muscle, *which prevents the healing of the abscess,* is put an end to. This then is the mode of curing the abscess: lay it open into the bowel, dividing at the same time the fibres of the sphincter muscle, which lie over it." (*Brodie.*)

For this purpose, the curved probe-pointed knife, with a narrow blade, is the most useful and handy instrument of any. This, introduced into the sinus, while the surgeon's forefinger is in the intestine, will enable him to divide all that can ever require division; and that with less pain to the patient, with more facility to the operator, as well as with more certainty and expedition, than any other instrument whatever. If there be no opening in the intestine, the smallest degree of force will thrust the point of the knife through, and thereby make one; if there be one already, the same point will pass through it. In either case, it will be received by the finger in ano; will thereby be prevented from deviating; and being brought out by the same finger, must necessarily divide all that is between the edge of the knife and the verge of the anus. (*Pott.*)

Besides the operation with the probe-pointed bistoury, as described by Pott, surgeons often practise another with a silver director and sharp-pointed bistoury. The director is introduced into the sinus, and then into the rectum, either through the internal opening, if one already exists, or by making it gradually penetrate through the coats of the bowel if no internal opening can be discovered. Then the director is to be bent, so as to make one extremity of it project through the anus; and the soft parts which lie over it divided, by passing the sharp pointed bistoury along its groove. (See *Brodie*, in *Lond. Med. Gaz.* for 1835, 1836, p. 184.) When there are several sinuses, and any of them are left undivided, the operation will probably not bring about a cure; hence the common maxim, that every sinus must be laid open.

Sir Benjamin Brodie usually divides the sphincter from within outwards with a probe-pointed bistoury, the cutting edge of which is slightly convex, The forefinger is passed into the rectum, quite above the sphincter, as a guide to the bistoury. The sphincter is then cut across, and the incision extended fairly into the surrounding fat; two or three strokes of the knife are generally required. In females, the incision should never be made towards the vagina, for it will never heal properly in this situation, and the sphincter will not become perfect again; so that the patient will be left with an incontinence of feces. In neither sex should the incision be directed towards the coccyx; because in this way only the inner fibres of the sphincter can be divided, and the contractile power of the muscle remains, and interferes with the cicatrization of the wound. (*Brodie*, *Op.* et vol. cit. p. 187.) The following remarks by Sir Benjamin Brodie deserve to be well remembered: — "The advantage of the division of the sphincter is not merely theoretical. There are few cases, in which it will not greatly facilitate the ultimate cure, preventing the burrowing of matter, and the formation of fresh sinuses, and rendering the subsequent dressings more easy to the surgeon, and less painful to the patient. It is, however, to the more complicated cases of fistulæ that the division of the sphincter is especially applicable; as, for example, where the sinus is of unusual extent, or where there are several sinuses, or where you are not certain that you have been able to detect the whole of them, or where the neighbouring parts are extensively indurated. It is quite a mistake to suppose, that there is any well-founded objection to even the most free division of the sphincter; even in the first instance it scarcely interferes with the retention of the feces, except they are actually liquid; and the muscle never fails to become perfectly united, and afterwards perform its functions as well as ever. Nor have I ever known any hemorrhage arise, which was not readily commanded by a dossil of lint introduced into the wound, and the pressure of the finger continued for a short space of time. If there be any considerable bleeding vessel, it is not difficult to secure it with the tenaculum and ligature; but this is seldom necessary." (*Op.* et vol. cit. p.184.)

Immediately after the operation, a soft dossil of fine lint should be introduced (from the rectum) between the divided lips of the incision; as well to repress any slight hemorrhage, as to prevent the immediate reunion of the said lips; and the rest of the sore should be lightly dressed with the same. Cramming the sinuses with lint, besides causing great pain, would prevent the free escape of purulent matter, and promote the formation of new sinuses. Sometimes it is advantageous to give a few drops of laudanum after the operation, on the principle specified by Sir Benjamin Brodie; namely, not with the view of relieving pain, but of occasioning costiveness, which will allow the dressings to remain undisturbed for two or three days. After this, a gentle aperient may be administered, which will prevent the ill effects of too long-continued constipation, and, at the same time, bring away the first dressings. Instead of immediately applying dressings again, Sir Benjamin Brodie prefers a poultice for three or four days, until the first inflammation consequent on the operation has subsided. After this, he dresses the sinuses daily, either with dry lint, or with lint spread with some stimulating ointment, or soaked in a stimulating lotion; always observing the rule to dress lightly. This first dressing should be permitted to continue until suppuration renders it loose enough to come away easily; and all the future ones should be as light, soft, and easy as possible. (*Pott.*)

When the matter is fairly formed, — when it points, and is fit to be let out, the opening should be made where such point is; that is, where the skin is most thin, and the fluctuation most palpable.

When a discharge of the matter by incision is too long delayed or neglected, the abscess makes its own way out, by bursting somewhere near to the fundament, or through the intestine into its cavity; or sometimes in both directions. In either case the discharge is made sometimes by one orifice only, and sometimes by more. Those in which the matter has made its escape by one or more openings through the skin only, are called *blind external fistulæ;* those in which the discharge has been made into the cavity of the intestine, without any orifice in the skin, are named *blind internal;* and those which have an opening both through the skin, and into the gut, are called *complete fistulæ.*

The most frequent of all are what are called the *blind external;* and the *complete.* The method whereby each of these states may be known is, by introducing a probe into the sinus by the orifice in the skin, while the forefinger is within the rectum.

Whether the case be what is called a complete fistula or not, that is, whether there be an opening in the skin only, or one there and another in the intestine, the appearance to the eye is much the same. Upon discharge of the matter, the external swelling subsides, and the inflamed colour of the skin disappears; the orifice, which at first was sloughy and foul, after a day or two are past becomes clean, and contracts in size; but the discharge, by fretting the parts about, renders the patient still uneasy.

As this kind of opening seldom proves sufficient for a cure (though it sometimes does), the induration, in some degree, remains; and if the orifice happens not to be a depending one, some part of the matter lodges, and is discharged by intervals, or may be pressed out by the fingers of an examiner. The disease, in this state, is not very painful; but it is troublesome, nasty, and offensive: the continual discharge of a thin kind of fluid from it creates heat, and causes excoriation in the parts above; it daubs the linen of the patient, and is at times very fetid: the orifice also sometimes contracts so as not to be sufficient for the discharge; and the lodgment of the matter then occasions fresh disturbance, an illustration of which is afforded in the case which I have quoted from Sir Benjamin Brodie.

The means of cure proposed and practised by our ancestors were three; viz. caustic, ligature, and incision.

The intention in each of these is the same, viz. to form one cavity of the sinus and intestine, by laying the former into the latter. The two first are now completely, and most properly, exploded.

Hitherto we have considered the disease either as an abscess, from which the matter has been let out by an incision made by a surgeon, or from which the contents have been discharged by one single orifice, formed by the bursting of the skin somewhere about the fundament. When, instead of one such opening there are several, the quantity of matter has been large, the inflammation of considerable extent, the cellular membrane sloughy, and the skin very thin before it burst, it was formerly believed that each of these orifices was an outlet from a distinct sinus, or hollow; but commonly these openings are only so many distinct burstings of the skin covering the matter; and do all, be they few or many, lead and open immediately into the one single abscess. Hence, as Pott argues, the treatment of this case ought to be very little, if at all, different from that of the preceding; and each of the orifices should be divided in such manner as to make one cavity of the whole. This the probe-knife will easily and expeditiously do.

When a considerable quantity of matter has been recently let out, and the internal parts have not yet had time to approach each other, the inside of such cavity will appear large; and if a probe be pushed with any degree of force, it will pass in more than one direction into the cellular membrane by the side of the rectum. But, as Pott justly remarks, let not the unexperienced practitioner be alarmed at this, and immediately fancy that there are so many distinct sinuses; neither let him, if he be of a more hardy disposition, go to work immediately with his director, knife, or scissors; let him enlarge the external wound by making his incision freely; let him lay all the separate orifices open into that cavity; let him divide the intestine and sphincter lengthwise by means of his finger in ano; let him dress lightly and easily; let him pay proper attention to the habit of the patient; and wait, and see what a few days, under such conduct, will produce. By this, he will frequently find that the large cavity of the abscess will become small and clean; that the induration round about will gradually lessen; that the probe will not pass in that manner into the cellular membrane; and, consequently, that his fears of a multiplicity of sinuses were groundless. On the contrary, if the sore be crammed or dressed with irritating or escharotic medicines, the hardnees will increase; the lips of the wound will be inverted; the cavity of the sore will remain large, crude, and foul; the discharge will be thin, gleety, and discoloured; the patient will be uneasy and feverish; and, if no new cavities are formed by the irritation of parts, and confinement of matter, yet the original one will have no opportunity of contracting itself, and may become truly fistulous.

Sometimes the matter of an abscess, formed near the anus, instead of making its way out through the skin, externally near the verge of the anus, or in the buttock, pierces through the intestine only. This is what is called a *blind internal fistula*. In this case, after the discharge has been made, the greater part of the tumefaction subsides, and the patient becomes easier. If this does not produce a cure, which sometimes, though very seldom, happens, some small degree of induration generally remains in the place where the original tumour was; upon pressure on this hardness, a small discharge of matter is frequently made per anum; and sometimes the expulsion of air from the cavity of the abscess into that of the intestine may very palpably be felt, and clearly heard; the stools, particularly if hard, and requiring force to be expelled, are sometimes smeared with matter; and although the patient, by the bursting of the abscess, is relieved from the acute pain which the collection occasioned, yet he is seldom perfectly free from a dull kind of uneasiness, especially if he sits for any considerable length of time in one posture. The real difference between this kind of case and that in which there is an external opening (with regard to method of cure), is very immaterial; for an external opening must be made, and then all difference ceases. In this, as in the former, no cure can reasonably be expected, until the cavity of the abscess, and that of the rectum, are made one; and the only difference is, that in the one case we have an orifice at or near the verge of the anus, by which we are immediately enabled to perform that necessary operation; in the other, we must make one.

Abscesses near the rectum frequently occur in patients who are labouring under tubercles and abscesses of the lungs. Hence, Sir Benjamin Brodie very properly recommends surgeons, before they operate on a patient for fistula, to ascertain whether the lungs are sound. "Persons, with diseased liver, and other visceral diseases (he observes, are also liable to the formation of these abscesses. The distinction of these cases from others, which occur in otherwise healthy subjects, is very important, inasmuch as the practice, which is proper in the one case, is quite improper in the other." (See *Lond. Med. Gaz.* vol. cit. p. 28.) He adds, if the patient labour under visceral disease, it is seldom that the abscess will heal; but if it should, the visceral disease will make increased progress, and the patient die sooner if the operation be performed than if it were let alone. (P. 29.) Every well-informed surgeon will likewise coincide in the prudence of not operating for a fistula, if stricture, or carcinoma of the rectum exist; for, under these circumstances, the sinus will not heal, even if it be laid open.

The surgery, required in these cases, consists in laying open and dividing the sinus, or sinuses, in such manner, that there may be no possible lodgment for matter, and that such cavities may be fairly opened lengthwise into that of the rectum. The dressings should be soft, easy, and light; and the whole intent of them to produce such suppuration as may soften the parts, and bring them into a state fit for healing.

If a loose fungous kind of flesh has taken possession of the inside of the sinus, a slight touch of the lunar caustic will reduce it sooner, and with better effect on the sore, than any other escharotic whatever.

Modern writers also speak of a smooth adventitious membrane, which is found to line old fistulæ, and frequently to hinder the success of the operation (see *Quarterly Journ. of Foreign Medicine, &c.* No. 8.); a complication, which would undoubtedly justify the recourse to measures for the extirpation of such membrane. But, my own belief is, that a case, hindered from getting well by this cause, is very rare in comparison with others, in which the cure is prevented by the matter being still more or less confined, and not having as free an outlet as circumstances demand.

If the bad state of the sore arises merely from its having been crammed and irritated, the method of obtaining relief is obvious. A patient who has been so treated, has generally some degree of fever; has a pulse which is too hard, and too quick; is thirsty, and does not get his due quantity of natural rest. A sore which has been so dressed, has generally a considerable degree of inflammatory hardness round about; the lips and edges of it are found full, inflamed, and sometimes inverted; the whole verge of the anus is swollen; the hemorrhoidal vessels are loaded; the discharge from the sore is large, thin, and discoloured; and all the lower part of the rectum participates in the inflammatory irritation, producing pain, bearing down, tenesmus, &c. All escharotics must be thrown out and disused; and, in lieu of them, a soft digestive should be substituted, in such manner as not to cause any distention, or to give any uneasiness from quantity; over which a poultice should be applied, and the patient should be enjoined absolute rest. At the same time, attention should be paid to the general disturbance, which the former treatment may have created. Blood should be drawn off from the sanguine; the feverish heat should be calmed by proper medicines; the languid and low should be assisted with bark and cordials; and ease in the part be obtained by the injection of anodyne clysters of starch and opium.

Abscesses are frequently formed about the lumbar vertebræ, under the psoas muscle, and near the sacrum; in which cases, the bones are sometimes carious, and sinuses may run down by the side of the rectum, and burst near the fundament. The treatment of such sores and sinuses can have little influence on the remote situation, where the collection of matter is originally formed. (See Lumbar Abscess.)

Sometimes, in attempting to cure what seems to be a common fistula, we find that it does not get well; and, in the end, a copious abscess is discovered higher up, which prevents the closing of the smaller sinus below. (See *Brodie*, in *Lond. Med. Gaz.* vol. for 1835, 1836, p. 28.) I have had opportunities of seeing several cases corresponding to this accurate description. In another place, Sir Benjamin Brodie, in adverting to a few cases which are met with, and kept from healing by some undetected sinus, relates the particulars of one instance, in which a lady had several sinuses near the rectum. Sir Benjamin Brodie laid open all he could find; but she continued uncured a considerable time, during all which she complained of uneasy sensations, which could not be accounted for. After repeated examinations, a sinus was detected high up, not more than an inch in length, and seemingly involving the levator ani. This having been laid open, a cure soon followed. (See *Lond. Med. Gaz.* for 1835, 1836, p. 185.)

Fistulous sores, sinuses, and indurations about the anus, which are consequences of diseases of the neck of the bladder, and urethra, called fistulæ in perinæo, require separate and particular consideration. (See Fistula in Perinæo.)

Some years ago, M. Roux published a critique on the preference which English surgeons invariably give to Pott's method of operating for the fistula in ano. The plan which he prefers, consists in the use of a kind of director, called a gorget, which is usually made of ebony or box-wood, and intended to be introduced within the rectum, with its concavity turned towards the fistula. A steel director, slightly pointed, and without a cul-de-sac, is then passed through the fistula, till the point comes into contact with the wooden gorget. A long, narrow, sharp-pointed, straight bistoury is now introduced along the groove of the steel director, till its point meets the groove of the ebony gorget, by cutting upon which all the parts are divided, which lie between the internal opening of the fistula and the anus. It may be objected to this method, that it is not always easy to make a director pass at once through the fistula into the rectum. This is acknowledged by Richerand, who adds, that, in this circumstance, the point of the director may be forced into the rectum, without lessening the chance of the success of the operation. (*Nosogr. Chir.* t. iii. p. 463, 464. ed. 4.) A flexible silver director will be more likely to follow the track of the fistula completely into the rectum, than a steel one; and the finger of the surgeon will always do the office of the wooden gorget with greater convenience. The only purpose which such a contrivance answers, seems to Sir Benjamin Brodie to be that of saving the surgeon's fore-finger; but, in using it, an advantage is lost, that of the sense of touch; "and (says he), in my own practice, I have found that I could complete the operation better with my fore-finger than the wooden gorget." (*Op.* et vol. cit. p. 184.) M. Roux censures us for not *cramming* the wound with charpie; for he is not content with merely introducing into it a dossil of lint. (See *Parallèle de la Chir. Angloise, &c.* p. 296. &c.) His countryman, Pouteau, however, long ago expressed his decided conviction of the inutility of cramming the wound with dressings to its very bottom, after the third day, when superficial dressings, and the renewal of them as often as cleanliness requires, will be fully sufficient. This agrees with the remark of Sir Benjamin Brodie, "That it is chiefly in consequence of the use of too much lint in dressing, that further operations are so frequently wanted before the cure is completed. The daily dressing should be repeated until the cut surfaces are cicatrised, but no longer. The cicatrisation of the bottom of the sinus will be completed better without the dressing than with it." (*Op.* et vol. cit. p. 185.) After the sinuses are healed, there is always a sort of fissure or chink left by the side of the anus. If the sinus has been deep, this chink will be deep in proportion; and then an inconvenience will follow, which may lead the patient to fear he is not cured, though he is so in reality. "The mucus of the rectum, sometimes stained with the feces, will flow through it and stain the linen. But (as Sir Benjamin Brodie adds), this is only temporary; the chink, however deep, will gradually close, and the mucus will ultimately be retained as well as ever."

Operations for fistulæ in ano may be followed by very troublesome hemorrhage; but this happens, I believe, chiefly in patients, whose hemorrhoidal vessels are enlarged, or where the surgeon deviates from the prudent advice delivered by

Sir Benjamin Brodie, with reference to such abscesses as are formed high up by the side of the rectum, and above the sphincter. In such cases, he directs the lancet to be carried through the skin by the side of the anus, until the matter flows. Then a probe-pointed bistoury is to be introduced, and the rectum divided at the lower part of the abscess, and the incision carried through the sphincter. It is quite unnecessary to lay the whole abscess open into the rectum, and it might give rise to a dangerous hemorrhage from vessels beyond the reach of the finger. (*Brodie, Op.* et vol. cit. p. 186.) Like all other mechanical injuries, operations for fistulæ may give rise to erysipelas, and, in some rare examples, to traumatic tetanus. With respect to erysipelas, Sir Benjamin Brodie notices its occasional extension in a few instances up the mucous membrane of the rectum into other parts of the intestinal canal; a formidable disease, the symptoms of which are peculiar, but not described by any other writer. "The pulse (says Sir Benjamin Brodie) becomes very rapid, and, at the same time, weak; then it is irregular and intermitting. The abdomen is tympanitic, in consequence of the intestines being distended with air; hiccough takes place; there is a great prostration of strength, and the patient often dies in the course of three or four days, sometimes sooner." On one lady, whom Sir Benjamin Brodie attended, the attack began when the wound of the operation was nearly healed up, and she died in less than forty-eight hours. He considers that, in consequence of the great prostration attendant on it, the disease demands the free exhibition of cordials and stimulants. (See *Lond. Med. Gaz.* for 1835, 1836, p. 185.)

Le Dran's Operations; *Sharp's* Operations; *La Faye's* Notes on Dionis. *H. Bass*, D. Fistula Ani feliciter curanda, in Halleri Disp. Chir. 4. 453. *J. L. Petit*, Traité des Mal. Chir. t. i. and ii. p. 113. *Kirkland's* Medical Surgery, vol. ii. Some of the best practical remarks ever published are contained in *Pott's* Treatise on the Fistula in Ano, in which he has offered also an excellent critique on the opinions of Le Dran, De la Faye, and Cheselden. *Sabatier*, Méd. Opératoire, t. ii. *J. Howship*, Practical Obs. on the Diseases of the Lower Intestines, &c. chap. 6. ed. 3. Lond. 1824. *T. Whately*, Cases of Polypi, &c.; with an Appendix, describing an improved instrument for the Fistula in Ano, 8vo. Lond. 1805. *J. T. Oetzmann*, De Fistula Ani, 4to. Jenæ, 1812. *Roux*, Voyage fait à Londres en 1814, ou Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise, p. 296. &c. Paris, 1815. *Schreger*, Chirurgische Versüche b. ii. Ueber die Unterbindung der Mastdarmfisteln, p. 1. 131. 8vo. Nürnberg, 1818. *Kothe*, Darstellung, &c. der Afterfisteln, in Rust's Mag. b. i. s. 259. *T. Ribes*, Recherches sur la Situation de l'Orifice interne de la Fistule de l'Anus, et sur les parties dans l'épaisseur desquelles ces ulcères ont leur siège, in Révue Méd. Hist. et Phil. Paris, 1820, livr. i. p. 174. *Fr. Reisinger*, Darstellung eines neuenn Verfahrens die Mastdarmfistel zu unterbinden, &c. 8vo. Augsb. 1816. *Sir Benjamin C. Brodie*, in Lond. Med. Gaz. for 1835 and 1836.

Anus, Prolapsus of.

Prolapsus ani, technically called also *exania*, or *archoptosis*, but, more correctly, *prolapsus recti*, is commonly described as presenting itself under three forms; in one, the protrusion of the rectum involves both its mucous and muscular tunics; in a second, its mucous coat alone; in a third, the upper portion of the bowel descends into the lower, and the displacement is truly what is termed a *volvulus*, or *intussusception*. In this account, Sir Benjamin Brodie believes that there is a mistake, and that prolapsus of the rectum is frequently confounded with internal piles. But the difference between internal piles and real prolapsus of the rectum, seems to him to be this: In the protrusion of the former, the mucous membrane covering them descends, and may be seen below the anus; but it is only the mucous membrane: whereas in a true prolapsus ani, the muscular tunic protrudes, as well as the mucous membrane. If one portion of bowel, inclusive of both these tunics, can slip down into another portion, why (inquires this distinguished surgeon) should not the rectum slip out at the anus? (See *Lond. Med. Gaz.* for 1834 and 1835, p. 845.) However, as I have already explained, the latter form of displacement is universally admitted; and the question which is raised refers to the point whether prolapsus ani ever really consists in a relaxation and protrusion of the mucous membrane of the rectum alone, without being essentially combined with internal piles. The inner coat of the rectum being connected to the muscular by a very loose elastic cellular tissue, naturally forms several folds, the use of which is to let this bowel dilate sufficiently for the retention of the excrement. This structure has appeared to some pathologists to account for the occasional protrusion of the mucous membrane, without being accompanied by the muscular coat. In one page, Baron Dupuytren speaks of "*la procidence de membrane muqueuse du rectum*," in common with other surgical writers; but, in the next, he describes the displacement as consisting in a descent of the upper portion of the rectum into the lower, down to the anus, and even beyond it, so as to constitute a protrusion from two to six inches in length. (*Clin. Chir.* t. i. p. 157, 158.) His view then seems to me to agree with that of Sir Benjamin Brodie. The swelling occasioned by the protrusion of the inner coat of the rectum, or of this, together with the muscular, is subject to considerable variety in respect to length and thickness; when small, resembling a mere ring; when large, and reaching far downwards, having an oblong globular form. The tumour sometimes admits of reduction with ease; sometimes it cannot be returned without difficulty. The disease is now and then met with in persons of all ages; but it is most common in infants and elderly subjects. When it exists in young adults, which is only seldom, Sir Benjamin Brodie has found that it has generally begun in early life. Children whose bowels are habitually confined, whose bellies are large and tumid, and in whom the contents of the abdomen seem too large for it, are more frequently, than others, affected with prolapsus ani. Sir Benjamin Brodie refers to an anatomical reason for the frequency of the complaint in children: — "It is because the prostate gland, urethra, and vesiculæ seminales, are not so much developed as in the adult. The attachment of the rectum to the surrounding parts does not extend so high in children as in persons of mature age; while the reflection of the peritoneum takes place lower down; and hence the rectum is more liable to be pushed out." (*Brodie*, in *Lond. Med. Gaz.* vol. cit. p. 845.) Such examples as are combined with thickening and relaxation of the inner coat of the rectum, internal hemorrhoids, or other tumours, are often attended with copious discharge of a thin mucous fluid, mixed with blood. The disease may originate from various causes: —

1. From circumstances tending to relax and weaken the parts, which retain the rectum, or its inner membrane, in its situation.

2. From various kinds of irritation and pressure on the bowel itself, having the effect of increasing the powers by which it is liable to be forced outward.

3. From any disease or irritation in the adjacent parts, and affecting the rectum sympathetically.

Hence, a prolapsus ani may be caused by long habitual crying, and great exertions of the voice; violent coughing; sitting long at stool; hard dry feces, and much straining to void them; obstinate diarrhœa, in infants, kept up by dentition; dysentery; chronic tenesmus; various diseases of the rectum itself; the abuse of aloetic medicines and emollient clysters; hemorrhoids; excrescences and thickenings of the inner membrane of the rectum; difficulty of making water; the efforts of parturition; a calculus in the bladder; paralysis of the sphincter and levator ani; and prolapsus vaginæ.

In general, the prolapsus takes place whenever the patients go to the water-closet, and, in some persons, it occurs whenever they are in the erect position. Dupuytren correctly notices, that this disposition of the rectum is often connected with a debilitated, relaxed constitution, and hemorrhoidal complaints. (*Clin. Chir.*, t. i. p. 158.)

The inconveniences vary in different cases. — Sometimes the bowel falls down only when the patient is costive, and he is expelling some hardened feces; and when pushed up, it remains in its place till some accidental circumstance brings it down again. In some cases it may be returned; but the moment the patient begins to walk about, it descends again. In others, of long standing, the bowel becomes so fixed in its unnatural position, that it cannot be returned. Then it is apt to become inflamed from friction, exceedingly painful, and sometimes ulcerated. (See *Brodie, Op.* et vol. cit. p. 845.)

Considering the degree of the disease, and the constriction by the sphincter, the symptoms are sometimes mild, the rectum generally bearing pressure, exposure to the air, and other kinds of irritation, better than any other bowel. Indeed, when the protrusion has continued a long while, the mucous membrane of the bowel becomes covered with a kind of cuticle. But the urgency and danger of a prolapsus ani are greater, when the swelling is large, recent, and conjoined with violent pain, inflammation, and febrile symptoms. When complicated with strangulation, the consequences may be a stoppage of the feces, severe pain, swelling, inflammation, and even gangrene. In short, all the evils may arise which attend strangulated hernia. The prognosis, therefore, varies according to the different degree, species, cause, and complication of the disease. The recent small moveable prolapsus ani, the cause of which admits of being at once removed, may be effectually cured. It should always be recollected, however, that when once the rectum has been affected with prolapsus, a tendency to protrusion from any slight occasional cause generally remains. The habitual prolapsus, which has existed for years, and comes on whenever the patient goes to stool, is the case most difficult of relief.

The treatment of prolapsus ani embraces three principal indications: —

1. The speedy reduction of the prolapsed part.
2. The retention of the reduced bowel.
3. The removal and avoidance of the causes, by which the disease has been induced.

In general, when the case is recent, and the tumour not of immoderate size, the reduction may be accomplished with tolerable ease, by putting the patient in a suitable posture, with the buttocks raised, and the thorax depressed, and by making gentle and skilful pressure, either with the palm of the hand or fingers. When difficulty is experienced, the patient, if young or robust, may be bled, and the part fomented. The large intestines may be emptied by means of a mild unirritating clyster, and half an ounce of the oleum ricini should be exhibited. In the habitual prolapsus ani, the patient himself is generally accustomed to reduce the part, or it goes up of itself when he lies down. When, however, the inflammation and swelling are urgent, there is a difference of opinion about the treatment, many writers stating, that the part ought on no account to be irritated by repeated attempts at reduction, and advising recourse to the antiphlogistic plan, especially leeches, fomentations, or cold washes, and the exhibition of the oleum ricini, and not attempting reduction until the swelling has been lessened. When the reduction is prevented by a spasmodic resistance, the use of an anodyne poultice, or fomentations, a clyster of the same quality, the warm bath, and the internal use of opium, are recommended. Should the complaint not give way to the preceding remedies, nor admit of reduction, and the symptoms become more and more pressing, perhaps the constriction should be obviated by dividing the sphincter with a bistoury, an operation sanctioned by Chelius. (*Handb. der Chir.* b. i. p. 775.) Cases are recorded, in which the protruded part, either in the state of gangrene, or of chronic hardness, thickening, and elongation was removed with a knife or ligature. (See *Cheselden's Anatomy, &c.* 1741; *Kersteus, Historia Sedis procidua, resectione feliciter sanatæ,* Kilon. 1779; *Whately,* in *Med. Trans. and Observ.* vol. viii. No. 16.) However, I should apprehend, that, in the circumstance of gangrene, the measures best calculated for stopping its course, detaching the sloughs, and keeping up the patient's strength, must always be more prudent than such an operation.

On the other hand, we have high authority for not imitating the plans above specified; and for trying to accomplish the reduction with less delay. The examples attended with difficulty of reduction, and hazard of gangrene, are noticed by Dupuytren. "Sometimes (he observes) the swelling of the parts is so great, and the sphincter so much inverted, that it strangulates the bowel, and aid is urgently required. The displaced organ is then of twice or thrice its proper size; assumes a red purplish colour, with an appearance of ecchymoses, and is sometimes in danger of sloughing to a greater or lesser extent. Under such circumstances, the reduction should be immediately performed in the following way: — The patient should lie on his belly, with the pelvis raised up by one or two pillows under it, so that the anus may be the highest part of the trunk. The tumour having been every where covered with wet cloths, and a compress laid over the centre of its outer end, gentle pressure is to be made on its base, in order to lessen its size; and then it is to be very gradually pushed towards the interior. Thus, the reduction commences with the part last protruded." *Dupuytren, Clin. Chir.* t. i. p. 159.) Scarifications and leeches he thinks objectionable. Undoubtedly, the removal of the part from its constricted state, by a prompt reduction of it, seems here as manifestly called for, as in a case of hernia; and, at all events, it is only when this is not immediately practicable, that other expedients are indicated.

The reduction having been effected, the forefinger should be passed up the rectum to ascertain that no intussusception exists above the sphincter. The bowel is then to be kept in its place by quietude and the recumbent posture; and, if there be a great tendency to relapse, it will be proper to apply to the fundament a piece of soft sponge, wetted with cold water, and supported with the T bandage. But if such means should not answer, and an habitual prolapsus ani recur, which is not unfrequent when the disease has been neglected, or its causes have long remained unremoved, some other apparatus like that described by Mr. Gooch, may be needed. (*Chir. Works*, vol. ii. p. 150. ed. 1792.) Trusses for prolapsus of the rectum may be procured. Others have used perforated balls of ivory. Callison found the introduction of a piece of sponge within the rectum, fastened to a silver probe, give effectual support. In France, and also in other countries, instruments made of elastic gum, have sometimes been employed. (*Richerand, Nosogr. Chir.* t. iii. p 444. ed. 4.) On account of the elasticity, and unirritating quality of this substance, I conceive it is better calculated than any other material for the construction of such instruments. It cannot be denied, however, that all foreign bodies in the rectum create serious annoyance. In the female sex, a vaginal pessary, rather prominent behind, will usually hinder the recurrence of the prolapsus. The horizontal posture should be observed as much as possible, and when the patient has a motion, a bed-pan should be placed under him. Astringent injections are to be employed daily. Sir Benjamin Brodie speaks also in favour of a course of Ward's paste. (See *Lond. Med. Gaz.* for 1834, 1835, p. 846.) Of the latter practice I cannot speak from experience, never having had confidence enough in it to give it a trial, which may not, I confess, be a fair way of deciding.

After the reduction of a prolapsus ani, the disposition which gave rise to the protrusion generally still continues; and therefore, as Dupuytren observes, the reduction is only to be regarded as a palliative, and, in some cases, as a means of preventing dangerous consequences; but never as a mode of accomplishing a permanent cure. Cold bathing and cold washes have been tried for the latter purpose, on the principle of strengthening the sphincter, so that the descent of the bowel may be opposed. But this method requires long perseverance, and is so disagreeable to some patients that it is soon given up. Astringent lotions and compression with a sponge and T bandage, suppositories which Dupuytren admits, do occasionally succeed in children, after a certain time, requently fail, and especially in adults and old pefrsons. (*Clinique Chir.* t. i. p. 160.) In such cases, recourse must be had to the operation first practised by Hey, or the modification of it adopted by Dupuytren.

The late Mr. Hey published some highly interesting remarks on the cure of the procidentia ani in adults. In one gentleman, the disease took place whenever he had a stool, and continued for some hours, the gut gradually retiring, and at last disappearing, until he had occasion to go to the privy again. After each stool, he used to place himself in a chair, and obtain a little relief by making pressure on the prolapsed part; and he then was in the habit of going to bed, where the intestine by degrees regained its natural situation. While the bowel was down, there was a copious discharge from it of a thin mucous fluid, blended with blood. When the part was up, the anus was constantly surrounded by a thin, pendulous flap of integuments, generally hanging down to the extent of three fourths of an inch. Around the anus there were also several soft tubercles of a bluish colour, situated at the basis, and at the inner part of the pendulous flap. These were evidently formed by the extremity of the rectum. The patient, previously to the establishment of these habitual attacks of prolapsus ani, had been afflicted for several years with pain after each stool, protuberances at the extremity of the rectum, and discharge of blood and mucus. For these complaints he applied to Mr. Sharp, who gave him an ointment to be applied after each stool, some soapy pills to be taken, and recommended the use of a clyster a little before the time of going to stool. The latter remedy, however, could not be adopted, and no material benefit was derived from the others. Some years afterwards, when Mr. Hey was consulted, the foregoing symptoms continued; in addition to which there was the grievance of the prolapsus, which came on at every time of going to stool, and lasted for several hours. This judicious surgeon at first advised the patient to wash the prolapsed part with a lotion, composed of an infusion of oak-bark, lime-water, and spirit of wine, and keeping on the tumour compresses, wet with this fluid, and supported by the T bandage. The disease, however, was too obstinate to be cured by this treatment. Nor could Mr. Hey succeed in reducing the bowel when it came down. "Although (says he) the prolapsed part of the intestine consisted of the whole inferior extremity of the rectum, and was of considerable bulk, yet the impediment to reduction did not arise from the stricture of the sphincter ani, for I could introduce my finger with ease during the procidentia; but it seemed to arise from the relaxed state of the lowest part of the intestine, and of the cellular membrane, which connects it with the surrounding parts. My attempt proved vain, as to its immediate object, yet it suggested an idea which led to a perfect cure of this obstinate disorder. The relaxed state of the part, which came down at every evacuation, and the want of sufficient stricture in the sphincter ani, satisfied me that it was impossible to afford any effectual relief to my patient, unless I could bring about a more firm adhesion to the surrounding cellular membrane, and increase the proper action of the sphincter. Nothing seemed so likely to effect these purposes, as the removal of the pendulous flap, and the other protuberances, which surrounded the anus." This operation was performed on the 13th of November. On the 15th the gut protruded, and did not gradually retire as it used to do. Mr. Hey attempted to procure ease by means of opiates and fomentations, and avoided immediately trying to reduce the prolapsed part. However, the prolapsus continued so long, that the appearance of the part began to alter, and, therefore, on the 16th he made an attempt at reduction, and succeeded with great ease. However, as a good deal of pain in the hypogastrium was still complained of, the patient was bled in the evening, and gently purged with the oleum ricini. These means gave relief; but, as some pain in the belly yet continued, an opiate was given. A low diet, linseed tea, lac amygdalæ, &c. were ordered, and a little of the oleum ricini every morning, or every other morning, with an opiate after a stool had been procured. "By proceeding in this manner for some days, regular stools were procured, without any permanent inconvenience. My patient recovered very well, and wasfreed from this distressing complaint, which had afflicted him so many years. (See *Hey's Pract. Obs.* p. 483. &c. ed. 2.)

This, and some other cases, which this gentleman has related, convincingly exemplify the necessity of paying attention to the removal of redundant skin, excrescences, hemorrhoids, and other tumours, situated about the lower part of the rectum, in cases of prolapsus ani; for, unless this object be accomplished, the disease may resist every other treatment. Mr. Howship prefers the ligature for the extirpation of the protuberances; but heartily commends the principle of the treatment proposed by Mr. Hey. (*Pract. Obs. on Diseases of the Lower Intestines,* p. 163. ed. 3.) An elderly gentleman, whom I know, was troubled for many years with a prolapsus ani, which used to come on several times a week, sometimes at the privy, and sometimes on other occasions. Several of the first surgeons were consulted, who failed in affording permanent benefit, because they omitted to extirpate some hemorrhoidal excrescences, situated at the lower part of the rectum; for, when these were afterwards removed, the prolapsus ani entirely disappeared.

Dupuytren finding, as Hey did, that the excision of piles, which so often accompany prolapsus ani, commonly prevented the return of the latter complaint, was led to cut off more or less considerable portions of the internal membrane of the rectum. However, as in one case a profuse hemorrhage took place, and, in another, a tedious suppuration, he subsequently adopted the plan of removing a certain number of the projecting folds, which may be seen converging from the circumference to the margin of the anus. The skin at the margin of the anus is thinner, and of a different colour from that of other parts; and contains numerous mucous cryptæ, which secrete an oily matter of a peculiar smell. It forms also prominent folds separated by fissures, which converge from the circumference of the margin to the centre of the anus. These folds extend up within the anus, and are the more numerous and prominent the closer the latter opening is; being effaced, when it is dilated. Their use is to facilitate such dilatation, and promote the evacuation of the feces. Beyond the skin is a stratum of fibro-cellular tissue, erectile tissue, as Cruveilhier calls it; higher up, the external sphincter; and still further up, the internal sphincter. (See *Dupuytren, Clinique Chir.* t. i. p. 161.) The method, practised by this distinguished surgeon, consisted in taking hold of some of these converging folds of skin, one after another, with a pair of broad-bladed dissecting forceps, and cutting them away in succession with a pair of scissors curved laterally. The excision was extended quite up to the anus, and even a few lines within it, if the relaxation were considerable, by the degree of which the number of folds to be removed is also determined; two or three being taken away on each side in moderate cases, and a larger number where the relaxation is very great. (See *Dupuytren,* in *Clinque Chir.* t. i. p. 162.) I have practised this operation very successfully in several cases. The principle, on which it answers, is precisely what Hey and Dupuytren have explained; the anus being immoderately dilatable, the surgeon cuts away a portion of one of its textures, and the rest becoming more consolidated, the tendency to too much dilatation is obviated. The contraction of the cicatrices, and the adhesion of the textures together, induced by inflammation, have the principal share in bringing about this desirable change.

Dupuytren, in his first method, used to cut away the mucous membrane itself; in the last, only the folds of skin at the margin of the anus are removed. A woman had had a constant prolapsus ani for ten years; when she was in the upright posture, the swelling was ten inches in one diameter, and seven in the other; it hindered her from walking, and continually discharged a mixture of blood and mucus. Dupuytren removed five or six of the projecting folds from without inwards. The patient, who used to have more than twenty stools a day, now went six days without one; on the seventh, however, an abundant evacuation took place, and the prolapsus never returned. Only simple dressings, as lint wetted with cold water, and a T bandage, are needed. (See *Journ. Universel des Sciences Méd.* No. 81. *Sept.* 1822.)

Although Dupuytren's operation bears some resemblance to Hey's, and is founded on the same principle, the French do not admit that what the latter did, will in any way affect the claim of the former to the merit of first suggesting a valuable improvement. They erroneously observe, that Hey's practice only related to prolapsus ani, as a consequence of piles; whereas that of Dupuytren is particularly adapted to examples, in which there are no piles. (See *Clinique Chir.* t. i. p. 166.)

The last indication in the treatment is the removal and avoidance, of all such causes as are known to have a tendency to bring on the complaint. In infants, a fresh protrusion of the rectum may sometimes be prevented by making them sit on a high night-stool, with their feet hanging freely down. Every thing tending to cause either diarrhœa, or costiveness, should be avoided. In the generality of cases, however, there is an inclination to costiveness, which must be obviated by the mildest means. For this purpose, Mr. Hey used to prescribe half an ounce of the oleum ricini, which is to be taken every morning, or every other morning, as circumstances may require. The same practitioner sometimes employed, in addition to this medicine, a clyster composed of a pint of water-gruel, and a large spoonful of treacle. The tone of the relaxed intestine is to be restored by the continued use of cold clysters, made with the decoction of oak-bark, alum, and vinegar. In one obstinate case, under the care of Mr. Hey, he recommended the following lotion for washing the part during the state of prolapsus; and he also advised its application to the anus in the intervals, by means of a thick compress, supported by the T bandage. ℞. Aquæ calcis simplicis lbij. Cort. quercûs contus. ℥iv. f. infus. per hebdomadam, et colaturæ adde sp. vini rect. ℥iv. ft, lotio. (See *Hey's Pract. Obs.* p. 442. ed. 2.)

In the treatment of a child, Sir Benjamin Brodie recommends occasional purging with calomel and rhubard; the avoidance of much vegetable food, which tends to fill up the intestines, while it affords but little nourishment; and an injection, every morning of two, or three ounces of a lotion, compound ʒj. of tinct. ferri muriatis, and a pint of water. The child is to retain the injection as long as possible. Sir Benjamin Brodie has never seen a prolapsus of the rectum in a child, which was not cured in this manner.

Intussusception of the higher part of the bowel, especially of the colon, or cœcum, causing a protrusion at the anus, is always incurable, as it is not in the power of art to rectify the displacement. Some extraordinary cases prove, however, that large portions of the intestinal canal, thus inverted, may slough and be voided, and the patients recover. (See Intussusception.)

According to Mr. Travers, when an artificial anus is complicated with prolapsus, the case rarely admits of cure. (See *Inquiry into the Process of Nature in repairing Injuries of the Intestines*, p. 374.)

Surgical writers have been too much in the habit of confounding together prolapsus ani and intussusception. In the latter disease, they have even fallen into the error of supposing, that the whole of the rectum becomes everted, in consequence of the relaxation of the sphincter and levator ani, and that it then draws after it other portions of the intestinal canal. But, they ought to have been undeceived by the strangulation, which sometimes occurs under such circumstances, and which not only throws a great obstacle in the way of the reduction of the displaced part, but even sometimes brings on mortification. Besides, the connections of the rectum with the neighbouring parts, by means of cellular substance, which surrounds it, and the attachment of this intestine to the posterior surface of the urinary bladder, render the above origin of the complaint impossible. Such an explanation could only be admitted with regard to those protrusions of the rectum, which come on in a very slow manner. It could not apply to certain cases, in which the everted intestine presents itself in the form of an enormous tumour. Fabricius ab Aquapendente met with cases of prolapsus of the rectum, where the tumour was as long as the forearm, and as large as the fist. In the *Mélanges des Curieux de la Nature*, is the description of a tumour of this sort, which was two feet long, and occurred in a woman from parturition. Nor is a more satisfactory reason assigned for these cases, by supposing that they originate from a relaxation of the mucous coat of the rectum, and its separation from the muscular one. We are not authorised to imagine, that such a separation can take place to a considerable extent, nor so suddenly, as to give rise to the phenomena sometimes remarked in this disease.

Accurate observations long ago removed all doubt upon this subject. In the *Mémoires de l' Académie de Chirurgie*, t. xi. ed. in 12mo., is an account of a pretended prolapsus of the rectum, which, after death, was discovered to be an eversion of the cœcum, the greater part of the colon being found at the lower end of this intestine, and most of the rectum at its upper part. This eversion began at the distance of more than eleven inches from the anus, and terminated about five or six from this opening, the tumour, formed by the disease, having been reduced some time before the child's death. It was impossible to draw back the everted part, in consequence of the adhesions which it had contracted. Another dissection evinced the same fact. A child, having suffered very acute pain in the abdomen, after receiving a blow, had a prolapsus of intestine through the anus, about six or seven inches long. This was taken for a prolapsus of the rectum. After death, the termination of the protruded bowel was found to be the cœcum, which had passed through the colon and rectum. (See Intussusception.)

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Anus, Artificial.

This signifies an accidental opening in the parieties of the abdomen, to which opening some part of the intestinal canal tends, and through which a variable quantity, or even the whole of the intestinal matters, or of the fèces, is involuntarily discharged. Of all the infirmities which assail the human race, none is more annoying and disgusting than an artificial anus; and, as a modern writer exclaims, what a wretched spectacle does a person exhibit, from whom the bilious alimentary matter and excrement are every instant involuntarily discharged! In vain is the aid of pouches, reservoirs, and boxes, for the palliation of his dreadful affliction; to him society is lost; and he is for ever doomed to lead a solitary and miserable life. Such, at all events, was the sentence pronounced by science, until the genius of Dupuytren came to reform, and restore to the world the unfortunate individuals, who seemed to be for ever banished from it. (*Leçons Orales de Clinique Chir.* t. iii. p. 193.)

An artificial anus is always preceded by an injury of the intestinal canal, either by a penetrating wound, or by ulceration of the bowel, and the bursting of an abscess externally; or by an operation, in which the preternatural opening is purposely made, with the view of saving life, in particular cases of imperforate anus; or by an accidental wound of the gut in the operation for hernia; or, lastly, and most commonly, by mortification of the bowel, the effect of the violence and long continuance of the strangulation of the part.

Foreign bodies, swallowed by mistake, have sometimes irritated the bowel, and caused it to become adherent to the peritoneum lining the parietes of the abdomen; then ulcerative inflammation ensued, followed by fecal abscess, and a fistulous opening, or true artificial anus. In a few uncommon instances worms, of the lumbrici kind, have excited the same consequences. As already stated, an artificial anus is sometimes the result of surgical operations, practised to prevent the fatal consequences of certain intestinal injuries or diseases; as when the bowel is cut completely across, and the surgeon deems it safer for the patient to establish an artificial anus, than to stitch the bowel; or where an imperforate anus, attended with an obliteration of the rectum, leaves the child the only chance of living by the formation of an artificial anus in the left iliac region. Lastly, the same thing has been suggested for cases, where an incurable obstruction of the intestinal canal, the rectum for instance, exists as the effect of some organic affection; or where the small intestines suffer internal strangulation. Dupuytren mentions these opportunities of making an artificial anus, with more confidence, however, than I am inclined to do. (See *Clin. Chir.* t. ii. p. 219.) All these cases are further divisible into such as are attended with a destruction of a portion of the intestinal tube; and into those which are not accompanied with any such loss of substance.

When once an artificial anus has been formed, it is a solution of continuity produced in the bowel and parietes of the abdomen, which are completely adherent to one another. The opening, in whatever way occasioned, is almost always roundish, but sometimes of an irregular shape. Its diameter varies from a few lines to an inch or more. In the majority of persons, its edges are thick, depressed, adherent to the subjacent parts, inclined towards the abdominal cavity, and immediately continuous with the mucous membrane of the bowel. A reddish circle denotes the place of their junction. The neighbouring integuments have radiating furrows in them, *en cul de poule*, analogous to what is observed near cicatrices in general; and notwithstanding the most minute attention to cleanliness, the matter evacuated irritates the skin, bringing on an erysipelatous redness, or excoriations of variable depth. (*Dupuytren, Clin. Chir.* t. ii. p. 196.)

Whatever may be the kind of injury which the bowel has sustained, one thing here invariably happens, viz. the adhesion of the two divided portions of the intestine to the edge of the opening in the parietes of the abdomen. This occurrence, which has the most salutary effect in preventing extravasation of the contents of the bowel in the cavity of the abdomen, is produced by the inflammation, which precedes gangrene, and follows wounds. (See *Œuvres Chir. de Desault*, t. ii. p. 352.—354.) In hernia, the adhesions precede the destruction of the parts; in wounds, they follow the division of the bowel; and hence, in these last cases, the solution of continuity frequently brings on a fatal effusion. The adhesions never ascend far along the extremities of the bowel; which, being only contiguous, and covered by a smooth membrane, as in other parts of them, leave between them a sort of *cul-de-sac*, the entrance of which is towards the belly, while the fundus is directed towards the skin. It is into this *cul-de-sac* that, in certain individuals, the abdominal viscera protrude, so as to occasion herniæ; which push the artificial anus outwards, compress, displace, and otherwise complicate it. (See *Dupuytren, Clinique Chir.* t. ii. p. 198.)

When, in strangulated hernia, the case is not relieved by the usual means, or when the necessary operation has not been practised in time, the protruded bowel sloughs; the adjoining part of it adheres to the neck of the hernial sac; and the gangrenous mischief spreads from within outwards. If the patient live long enough, and an incision in the tumour be not now practised, one or more openings soon form in the integuments, and, through these apertures, the feces are discharged until the separation of the sloughs gives a freer vent to the excrement. But when an incision is made, the feces are more readily discharged; and, as Mr. Travers has related, this is sometimes the best mode of relief. "In the ordinary situation of hernia, the portions of intestine, embraced by the stricture, occupy a position nearly parallel. Their contiguous sides mutually adhere; in the remainder of their circumference they adhere to the peritoneum, lining or forming the stricture. The existing adhesion of the contiguous sides, strengthened by the adhesion of the parts in contact, ensures a partial continuity upon the separation of the sphacelated part. The line of separation is the line of stricture. It commences on that side of the gut which is in direct contact with the stricture. As the separation advances, the opposite adhering sides may perhaps recede somewhat, and a little enlarge the angle of union. But, it is ever afterwards an angle; and where the peritoneum is deficient, the canal is simply covered in by granulations from the cellular membrane of the parietes, coalescing with those of the external or cellular surface of the peritoneum." (*On the Process of Nature in repairing Injuries of the Intestines*, p. 360.) It must be confessed, that few surgeons have entertained sufficiently accurate ideas of the changes which happen around the wounded or mortified portion of intestine, when an artificial anus is produced; and though Desault's account was excellent, so far as it went, it was not until the year 1809, when Scarpa published his valuable work on Hernia, that the whole process of nature on such occasions was completely elucidated. The hernial sac (says he) does not always partake of gangrene with the viscera contained in a hernia; and even when it does slough, since the separation of the dead parts happens on the outside of the abdominal ring, there almost always remains in this situation a portion of the neck of the hernial sac perfectly sound. It may be said, therefore, that, in all cases, immediately after the detachment of the mortified intestine, whether it happen within, or on the outside of the ring, the two orifices of the gut are enveloped in the neck of the hernial sac, which soon becoming adherent to them by the effect of inflammation, serves for a certain time to direct the feces towards the external wound, and to prevent their effusion in the abdomen. In proportion as the outer wound diminishes, the external portion of the neck of the hernial sac also contracts; but *that part, which embraces the orifices of the intestine, gradually becomes larger, and at length forms a kind of membranous, funnel-shaped, intermediate cavity, which makes the communication between the two parts of the bowel.* However, according to Scarpa's investigations, this adhesion of the neck of the hernial sac round the two orifices of the gut, does not hinder the latter from gradually quitting the ring, and becoming more and more deeply placed in the cavity of the abdomen. The base of the above-described funnel-shaped membranous cavity corresponds to the bowel, and its apex tends towards the wound, or fistula.

But, in relation to this part of the subject, there are some other circumstances which every surgeon should well understand, and his ignorance of them would not be excusable, on the ground of their not having been, like the funnel-shaped membranous cavity, forming the communication between the two orifices of the bowel, only a discovery of recent date; for they were fully explained many years ago. I here allude to the exact position of the two portions of the bowel, with respect to each other, the direction of their orifices, the angle or ridge between them, and the difference in their diameters. The first of these circumstances, viz. the position of the two parts of the bowel, was correctly described by Saviard, Morand, and Desault; and, as we have seen, is pointed out by Mr. Travers, who represents them as occupying a position nearly parallel, and cites an interesting observation recorded by Pipelet. The patient was a woman fifty-six years old; the loop of spoiled gut was from five to six inches long; the contents of the bowel were discharged through the wound for a considerable time, and an artificial anus was established. Some accidental obstruction occurred; a purgative was given, which operated in the natural way, and in fifteen days the wound was healed. She lived in perfect health to the age of eighty-two, when she died of a disease not connected with this malady. Pipelet examined the body, and has given a figure representing the union. The line of the intestine formed an acute angle, where it adhered to the peritoneum, opposite to the crural arch. The cylinder is evidently much contracted. Pipelet particularly dwells upon the angular position, and constriction of the tube at the point of union. The lower continuation of the intestinal tube was also remarked to be more contracted than the upper portion; a circumstance correctly referred, by Mr. Travers, to the undilated state of the bowels, situated between the artificial and the natural anus. (See *Mém. de l'Acad. de Chir.* t. iv. p. 164.; and *Travers on Injuries of the Intestines*, p. 364.) The two ends of the bowel, as Scarpa has observed, are found lying in a more or less parallel manner by the side of each other; the upper with its orifice open, and directed towards the external wound by the feces, which issue from it; while the lower, which gives passage to nothing, becomes less capacious, and is retracted further into the abdomen; or, as Dupuytren, observes, the two terminating portions of bowel pass into the abdomen, sometimes crossing, sometimes coiling over one another; in other instances, running parallel; but most frequently diverging at a more or less acute angle. Lastly, they terminate in bending more and more, to become lost in the convolution of the intestinal canal. (See *Dupuytren Clinique Chir.* t. ii. p. 202.) According to Scarpa, the breach in the intestinal canal is never repaired by the orifices of the upper and lower portions of the bowels reuniting, coalescing, and running as it were into each other. Indeed, they meet at a very acute angle; the axis of one does not correspond to that of the other; and their orifices never lie exactly opposite each other. It is, in short, by means of the funnel-shaped cavity, formed by the remains of the hernial sac, that the two parts of the bowel communicate; and the feces, in order to get from the upper into the lower continuation of the intestine, must first pass in a semicircular track through that funnel-shaped cavity, there being between the orifices of the bowel, directly opposite to the communication between the cavity of the intestine and that of the funnel-shaped membrane, *a considerable projection, or jutting angle, forming a material additional obstacle to the direct passage of the feces from the upper into the lower portion of the intestinal tube.* (*Scarpa sull' Ernie Memorie, Nat. Chirurgiche*, Milano, 1809.)

This éperon, as it is named by the French, is mentioned both by Saviard and Morand. It consists, in fact, of the part of the bowel which has been spared by gangrene, or a wound in the direction towards the mesentery; and it advances more or less towards the skin, in proportion as the bowel has experienced a greater or lesser loss of substance, or a greater or lesser change of direction. When the bowel has only been wounded, or the seat of a small slough, and it pursues its natural course, the projection is trivial and concealed; but very large, reaching the level of the skin, when the whole circumference of the bowel has been destroyed; and, in consequence of the loss of substance, its two ends meet at an acute angle, or run parallel to one another. In the first case, there is between the two orifices of the bowel a cylindrical channel, more or less deep, which may still convey matters from the upper to the lower end. This case is most easy of cure. In the other, no trace of such a channel is discoverable; and the jutting angle, the éperon, between the two orifices of the intestine, forms a barrier which the intestinal matter cannot pass. Thus the difficulties are greater, and the resources of surgery less certain. (See *Dupuytren Clin. Chir.* t. ii. p. 203.) Whatever may have been the original state of this projecting angle, after a certain time it does not divide the bottom of the funnel-shaped tube, where the orifices of the intestine are, into two equal parts; because it is propelled towards the lower portion of the bowel, by the pressure of the matters passing through the orifice of the upper end. By degrees the orifice of the lower end becomes indeed covered by it as by a valve, and is detected with difficulty.

Towards the interior of the bowel, Dupuytren found that the éperon had constantly the shape of a crescent, while towards the cavity of the abdomen the two equal halves of it diverged from one another to receive the mesentery in the interspace. The éperon, therefore, is composed of a single wall only at its sharp edge, and every where else it consists of two parietes, leaving between them a triangular interval, which becomes greater as the two portions of the bowel recede from one another in their course into the abdomen. From this latter disposition, says Dupuytren, a fact of the highest importance arises; viz. that the cavities of the two ends of the intestine are separated from one another by a double septum, the surfaces of which, on the side towards the belly, are smooth, and free from all adhesion together. To get, therefore, from one of these cavities into the other, through their parietes, the cavity of the peritoneum must of necessity be pervaded: hence the difficulty and danger in trying to form a communication between the two ends of the bowel by attacking the septum between them. (See *Dupuytren, Clinique Chir.* t. ii. p. 204.)

Another interesting circumstance, explained by Dupuytren, is, that the jutting angle, and double septum, the continuation of it, are not invariably so fixed as to be totally incapable of advancing or receding; but, being connected with the mesentery, they are, in a certain degree, obliged to follow the movements communicated by it to them. Sometimes, when hernia is combined with adhesions, the mesentery, which becomes elongated, and forms a cord between the spine and the displaced bowel, keeps the trunk immutably bent forwards. In cases of artificial anus, the end of this cord, corresponding to the intestine, is attached to the bottom of its angle on the side towards the belly, precisely at the base of the éperon interposed between the two orifices. Hence the éperon, and the bowel terminating at it, must be continually drawn towards the cavity of the abdomen by the mesentery: and thus we may discern how the motion and posture of the trunk backward should have a favourable influence in promoting a spontaneous cure. Sometimes, however, the tension of the mesenteric cord ruptures the adhesions of the ends of the bowel to the parietes of the abdomen, and causes a fatal effusion of intestinal matter within the peritoneum. Long after the spontaneous cure of an artificial anus, the effect of this action of the mesentery may be to separate the bowel completely from the parietes of the abdomen, and restore it to its free and floating condition again. Dupuytren ascertained this fact by *post mortem* examinations; a fact, which he would have had difficulty in crediting, if he had not been perfectly certain of the identity of the individuals, and had not detected in each of them a fibrous cord extending from the point of the parietes of the abdomen, corresponding to the former artificial anus, to the bowel. (See *Clinique Chir.* t. ii. p. 206.)

It is then in the deeper part of the funnel-shaped tube, which, as we have seen, lies between the opening in the skin and the bottom of the artificial anus, that the most remarkable and important dispositions of an artificial anus are placed. Here are situated the orifices of the two ends of the intestinal canal, and the septum between them. Of these two orifices, one belongs to the upper part of the bowel; and, being always pervaded by alimentary matter, or feces, is the freer and larger; the other is continuous with the lower portion of the bowel; and since it transmits no alimentary nor fecal matter, or only trivial quantities, it is usually narrow, contracted, and not readily detected. Next to these orifices are the extremities of the bowel, constituting their termination.

Desault, after noticing the efficiency of the adhesions, between the injured part of the bowel and the edge of the opening in the parietes of the abdomen, in preventing extravasation, remarks, that if such adhesions were entire, the abdominal parietes would form a substitute for the portion of the canal which has been destroyed, and the contents of the bowel would continue to pass, as usual, towards the anus, were it not that the portions of the intestine, separated and adherent to the neighbouring parts, form such an acute angle as obstructs the passage of the intestinal matter. The more acute this angle is, the greater is the obstruction; when the two parts of the bowel lie nearly parallel, the entrance into the lower portion of the canal is completely prevented; but if they meet at a right angle, then more or less of the contents of the upper portion may be transmitted into the lower. The first disposition chiefly happens when a considerable part of the intestinal canal has been destroyed, or when the tube has been completely divided; while the second posture is principally remarked in all cases where the injury has been less extensive. And it is plain that the possibility of a cure depends materially on the kind of angle, at which the two portions of bowel meet, and that the projection of the internal frænum, or jutting membranous ridge between the two orifices, is always a greater or lesser obstacle to the cure.

With respect to the diminution which occurs in the diameter of the part of the intestinal canal, between the artificial opening and the natural anus, Desault admits the correctness of the observation, but entirely dissents from such authors as have spoken of the change as sometimes proceeding so far that an obliteration of that portion of the intestinal tube is the consequence. The mucus secreted within it suffices for preventing this obliteration; a secretion which, in these cases, is copious, and is partly voided from the rectum in the form of white flakes. And, if any further proof were needed that the bowels between the artificial and natural anus remain pervious, it is furnished by the fact, that, in cases of artificial anus, the lower continuation of the tube frequently becomes inverted, and protrudes. On the other hand, the kind of obliteration above spoken of has never been demonstrated by dissection: it was not observed by Lecat, in the examination of the body of a person, who died twelve years after the entire cessation of the passage of feces *per anum;* nor was it found to exist by Desault, when he opened a patient who died of marasmus in the Hôtel Dieu, in consequence of an artificial anus, which communicated with the ileum, and had lasted two years. (*Œuvr. de Desault*, t. ii. p. 354 — 356.)

It is true, then, that the lower portion of the intestinal canal undergoes a kind of atrophy, but, perhaps, is never obliterated or rendered quite impervious. Such atrophy, according to Dupuytren, extends to the corresponding part of the mesentery and mesenteric glands; and after some years, such is the difference between the upper and lower parts of the intestinal tube, that while the former seems to be that of an adult, the other looks as if it belonged to a new-born infant. (*Clinique Chir.* t. ii. p. 210.)

I believe the only case, forming an exception to the assertion of Desault, that the lower portion of the intestinal canal is never obliterated, is that met with by M. Bégin, in the *Val de Grace.* It was that of a man, eighty years of age, who, for forty years before he died, had been afflicted with artificial anus, communicating with the transverse arch of the colon. The intestine below the artificial anus was transformed into a solid cord, not larger than a quill, until it approached the anus, when its diameter increased, and its solidity lessened. Here it contained also a whitish mucus; and in other parts was only capable of admitting a small probe, except for the space of six or eight inches towards the artificial anus, where its cavity was totally obliterated. (See *Dict. de Méd. et de Chir. Pratiques*, t. iii. p. 133.)

However proper the formation of an artificial anus may be in many cases, in which the patient's life depends upon the event, it must be confessed that the consequence is a most afflicting and disgusting infirmity. This truth cannot be denied, though the feces which are discharged, from not having been so long retained in the bowels, may not be so fetid as those which are evacuated in the ordinary way. As the opening which gives vent to the excrement, is not endued with the same organization as the lower end of the rectum, and as, in particular, it is not furnished with any sphincter capable of contracting and relaxing itself, as occasion requires, the feces are continually escaping without any knowledge of the circumstance on the part of the patient. Hence the uncleanly state of the parts around the external opening, and their frequently excoriated fungous state. Some persons in this state, among the number of those whose histories are on record, made use of a metal box, in which their excrement was received. Schenckius relates the case of an officer who was wounded in the belly, and who allowed his feces to escape into a vessel made for the purpose. Dionis mentions a similar case.

Moscati also communicated to the Academy of Surgery, the history of a wounded man, in whom an artificial anus took place, in consequence of a wound in the abdomen below the right hypochondrium. His excrement used to be received in a tin box, fastened to him with a belt. The wound received a leaden cannula, to which the tin box was accommodated.

Uncleanliness is not the only inconvenience of an artificial anus. Persons have been known to be quite debilitated by the affliction, and even ultimately to die in consequence of it. This is liable to happen, whenever the intestinal canal is opened very high up, so that the aliment escapes before chylification is completed, and the nutritious part of the food has been taken up by the lacteals. In this circumstance the patient becomes emaciated, and sometimes perishes, as Desault had an opportunity of observing; and examples of which are also recorded by Hoin and Le Blanc. In cases of this description, the matter voided has little fetor, and is frequently sourish. In all instances, the matter is evacuated involuntarily, because there is nothing like a sphincter. But when the opening only communicates with the lower convolutions of the ileum, or, what is more frequent, with the large intestines, the danger is less serious, and patients in this state are often noticed performing all their functions very well; and, with the exception of colic, to which they are subject, enjoying as good health as they did previously to their having the present disease. In such examples, the matter voided is more fetid, its discharge does not follow so quickly its introduction into the stomach, and it is retained for a longer time.

On this part of the subject, the investigations of Dupuytren led to some interesting information, which was, that the upper or stomachic portion of the intestinal canal not only preserves its calibre, motion, and natural appearance, but, in consequence of having an increased duty to perform, it acquires an increase of capacity, and becomes the seat of a more energetic circulation, as well as of more active secretion and absorption. This excess of life, says he, is propagated even to the mesentery and its glands.

In cases of artificial anus, the regular convolutions of the bowels, so favourable for the advance of their contents, are immediately affected at some point or another. A noose of intestine is elongated, and drawn towards the breach in the parietes of the abdomen; it assumes the form of a triangle, the base of which is the mesentery, while one side is the stomachic portion, the other the anal continuation of the intestine. In every simple hernia, we see the difficulty occasioned to the free course of the intestinal matter, by the deviation of the bowel from its regular and uniform curve, and its assuming an angular direction. Besides, as Dupuytren has admirably explained, the bowel being, in cases of artificial anus, fixed by adhesions to the parietes of the abdomen, this state not only resists the motions of the digestive tube, but it makes the adherent portion of the bowel a fixed point, towards which all the efforts of the intestinal canal are concentrated, and towards which its contents are incessantly directed: whence a true acceleration of them from the stomach to the artificial anus. A still more serious inconvenience is the shortening of the track which they have to pass. Their lodgment in the intestinal canal being abridged, their digestion remains incomplete, and the absorption of their nutritive principles is performed with less precision. Then nutrition is impaired, and the exhaustion threatens to render the continuance of all the organic functions impossible. (See *Dupuytren, Clinique, Chir.* t. ii. p. 213.)

Many patients, afflicted with an artificial anus, void no feces at all from the rectum; but, occasionally, a thick whitish substance, which is the mucous secretion of the portion of the large intestines nearest to the anus. Under certain circumstances, the quantity of this mucous discharged is more copious. (*Desault*, vol. cit. p. 359.)

One disagreeable occurrence, to which persons with an artificial anus are exposed, is a prolapsus of the bowel, similar to what sometimes happens through the anus with respect to the rectum. The descent of the bowel is sometimes simple, only affecting a portion of the intestinal canal just above, or below, the opening. On other occasions, the complaint is double, the bowel both above and below the opening being prolapsed. This descent of the intestine forms a tumour, the dimensions of which vary considerably in different subjects. Instances have been known of its attaining the length of sixteen or eighteen inches, or even two feet. (*Dupuytren, Clinique Chir.* t. ii. p. 200.) The surface of the prolapsus is reddish, like that of the inside of the intestine, though discoloured by the irritation of exposure to the air. When it has been of long continuance, the mucous membrane becomes dense and solid, covered with a thin dry cuticle, and assumes the characters of cutaneous texture. (See *Dupuytren*, vol. cit.) When the protrusion is caused by the upper part of the intestinal canal, the feces are voided at the extremity of the tumour; and, when the swelling consists of the lower portion of the bowel, the excrement is evacuated at the base of the prolapsed part. By observing this evacuation, when the tumour is double, it is easy to know to which end of the intestinal canal each protruded portion belongs. This consequence of an artificial anus is very serious, because it greatly increases the inconvenience which the patient suffers. Sometimes the tumour is exquisitely sensible; and, occasionally, when the eversion of the intestine is considerable, a strangulation is produced, which puts the patient's life in danger.

An artificial anus, particularly that formed by the destruction of the whole calibre of the bowel, rarely continues a simple fistulous opening, but, almost always, becomes complicated with a prolapsus of the intestine, the interior of which becomes everted, as well as protruded. This happens with greater facility, in proportion as the intestine is less fixed in the cavity of the abdomen. The protrusion is more considerable, in proportion as the efforts of the patient at stool are greater; and it is the more afflicting, the older the artificial anus is. The prolapsus, or protrusion of the lower end of the bowel, is less common than that of the upper; not so voluminous; and seems to be occasioned by the antiperistaltic movements which propel the mucous secretion of the lower part of the intestinal canal towards the artificial anus. (See *Dupuytren, Clinique Chir.* t. ii. p. 199.) These tumours are usually of an elongated conical shape, with the apex in the integuments, and a depressed aperture in the base, whence is discharged stercoraceous matter, if the prolapsus be connected with the upper portion of the bowel; and mucus, or even the fluid of clysters, if connected with the lower.

I apprehend no well-informed surgeon of the present day can doubt, that formerly the frequency of artificial ani after hernia was seriously increased by the absurd measures sometimes adopted for the express purpose of preventing them; and as Mr. Travers has rightly observed, the cases reported by the old surgeons, if they prove any thing, prove this: " that the canal has been very generally restored, when the artificial anus was reckoned upon as inevitable; and that where an officious solicitude had been at work to prevent it, showing itself in an active interference with the arrangements of nature, the case has terminated in artificial anus; so that the event, either way, has been a matter of surprise to the surgeon. The fear of doing too little, or too much, applies only to the pernicious customs of dilating the stricture, displacing, amputating, and sewing the intestine; the general adoption of which practice fully accounts to my mind for the number of artificial ani, which are the sequelæ of hernia." (*Op.* cit. p. 367.)

With respect to the prognosis, it *is* universally agreed, that cæteris paribus, an artificial anus is more dangerous the nearer it is to the stomach, for reasons already explained. An opening produced by injuries of the cæcum, colon, or rectum, has scarcely any effect on that part of the digestive function termed assimilation. The risk is also in some measure greater, in proportion as the quantity of intestinal matter voided from it is more considerable. The prognosis is more favourable, when the two orifices of the bowel are readily found at the bottom of the artificial anus, than when only the orifice of the upper end is discoverable. Lastly, the more free an artificial anus is from complications and accidental ill consequences, the less is the patient the subject of annoyance and danger. (See *Dupuytren, Clin. Chir.* t. ii. p. 223.)

The treatment of an artificial anus, is either palliative or radical. The first consists in obviating the habitual uncleanliness produced by the involuntary discharge of the intestinal matter, and in relieving any unpleasant symptoms present.

The first indication is fulfilled by the employment of silver, or tin machines, which are either kept applied to the external opening by means of a spring, or form receptacles placed more or less off the artificial anus, from which the intestinal matter is transmitted through a tube, kept constantly in the opening. In general, says Desault, as elastic gum is supple, light, and capable of taking any shape, it is the best material for the construction of such instruments, which, however, rarely answer their purpose completely.

Richter, with the view of hindering the too quick escape of the intestinal matter, and the death of the patient from this cause, proposed covering the opening for a certain time with a piece of sponge, supported by an elastic bandage, or truss. But Loeffler found this method objectionable, as it was apt to bring on colic, constipation, and an inflamed excoriated state of the skin.

When the outer opening is disposed to contract too much, and *inconveniences arise from this change,* Sabatier is an advocate for preventing such closure by means of a tent, or skein of silk, introduced into the aperture, and changed very often for the sake of cleanliness; while others prefer a ring of ivory for the purpose. But the irritation, produced by the matter imbibed by this sort of tent, and in particular the liability of the bowel to protrude, and be strangulated in the opening of the ivory ring, are found strong objections to these practices; and, according to Desault, who preferred a linen tent, compress, and bandage, the sponge employed by Richter also occasions a great deal of excoriation by the irritation of the fluid lodged in it.

The investigations of Scarpa and Dupuytren fully prove, that the causes of the discharge of the intestinal matters through an artificial anus, and the obstacles to their resuming their natural course, and to a radical cure, depend, — 1st, Upon the adhesion, angular direction, and fixed condition of the bowel. 2d, Upon the loss of substance which it has sustained, and the consequent contraction of it. 3d, Upon the jutting angle (*éperon*), and the double septum between its two ends. These obstacles, great as they may be, are sometimes overcome by nature and art. Loss of substance is indeed irreparable; but amends for it may be made in certain cases by a dilatation of the calibre of the bowel. Its adhesion to the parietes of the abdomen may also become less close, or even so loosened as to let the bowel assume a position and direction more favourable for the re-establishment of the course of its contents. The projection, formed by the *éperon* and double septum, may also be lessened by being continually dragged by the mesentery, and subjected to the effort of the intestinal matter to get from the upper into the lower portion of the bowel. A rich full diet is recommended by M. Louis, for the purpose of gradually enlarging the communication between the two portions of bowel: purgatives, administered with the view of forcing the obstacles to a free communication; the introduction of tents, the size of which is gradually increased, in order to dilate the contraction between the two parts of the intestine; the motions and position of the trunk backward, advised by Dupuytren to render the mesentery tense, and to efface the projecting angle and the septum continued from it; compression of the external opening, practised from time immemorial, to hinder the intestinal contents from escaping outwards, and obliging them to pass by the natural way, — are all, as Dupuytren observes, so many resources, which, employed singly or unitedly, have accomplished many cures. (See *Clinique Chir.* t. ii. p. 225.)

But every body must agree with this distinguished practitioner, that, previously to attempting to cure the principal disease, all accidental complications should be removed; as an indurated or inflamed state of the skin, extensive sinuses, or a prolapsus of the intestine. The latter, according to Dupuytren, is easily obviated by keeping the patient a few days on his back, and having recourse to the taxis with gentleness, and moderate steady compression. Almost all artificial ani, attended with a simple perforation of some point of the circumference of the bowel, are set down by Dupuytren as curable. These cases are in reality but stercoraceous fistulæ, behind which the intestinal canal is almost entire, without loss of substance, or any manifest contraction, or material change of direction. Here nature is disposed to close the accidental opening, and her efforts, assisted by moderate compression, are mostly successful. But Dupuytren explains that this simple treatment will not answer, when the artificial anus has been produced by the destruction of a third or a half of the circumference of the bowel, for an extent varying from a few lines to an inch. Yet, here the loss of substance, the changed direction of the intestine, and the jutting angle between the two portions of it, are not so considerable as to prevent the restoration of the natural passage for the intestinal matter from being brought about by suitable treatment. Nay, he adds, that cases are not absolutely incurable by the plans above adverted to, even when the artificial anus was the consequence of a loss of substance, involving two thirds or three quarters of the circumference of the bowel, with a proportionate length of it. But, when the loss of substance amounts to four-fifths, or the whole of the circumference, with or without the inclusion of a piece of the mesentery, such methods will not avail. Here the diminished calibre of the bowel, its altered direction, the jutting angle, and the double septum, present themselves in the strongest manner as invincible impediments to the re-establishment of the natural course of the alimentary matter; and, as Dupuytren further remarks, pressure, which, when made with precision, is the most effectual means of closing the outlet, immediately brings on colic, nausea, hiccough, vomiting, and all the symptoms of strangulated hernia.

From a calculation made by Dupuytren, it appears that artificial ani, capable of spontaneous cure, or of one produced by the means already specified, are, in comparison with the examples which obstinately resist such treatment, as three to one. (See *Clin. Chir.* t. ii. p. 223. 229.) It was for this obstinate fourth of cases of artificial ani, that Dupuytren devised a method of cure, which reflected upon him the highest credit.

The business of the surgeon is to prevent, if possible, the formation of an artificial anus; but, when the event has occurred, and, particularly, when the whole, or the greater part, of the stools is discharged in this way, no attempt must be made to stop up the opening, without a great deal of consideration; for any effort of this kind, made under circumstances which do not justify it, may be the means of exposing the patient's life to the most alarming danger. Sometimes, indeed, without any interference of the surgeon, the outward opening contracts, and, the issue of the intestinal matter being obstructed, pain and tenesmus are excited: and the same consequences may be produced by any swelling and enlargement of the projecting ridge, situated between the two portions of the bowel. In two cases, Puy found this swelling take place in such a degree, that the patients fell victims to the complete stoppage of the intestinal contents. The symptoms, which arise, are then similar to those which happen in strangulated hernia. Hoin, Le Blanc, and Sabatier, also cite instances, in which the patients lost their lives by gangrene, brought on by this species of strangulation. (*Desault*, vol. cit. p. 360.)

There is a period (says Mr. Travers), at which the function of the lower portion of the canal, with a little assistance, may be restored. The natural order of events, connected with this recovery, has been mistaken and inverted. Practitioners have closed the wound, instead of conducting the matter by purgatives and clysters into the large intestines. Now, the wound will never fail to heal, when the matter recovers its accustomed route; but this condition cannot be reversed. The restoration is safest, when most gradual; when there is evidence of an existing sympathy between the repair of structure, and the return of function. According to the same gentleman, there is reason to believe that the well-timed exhibition of a single purgative might often prove effectual. "If the food is rapid, and little changed in its passage, it should be pultaceous and nutritive, and given in moderate quantity at short intervals; while injections of the same kind should be administered at least twice in twenty-four hours, and retained as long as possible." He states, that by such means patients may be nourished for many weeks. If the discharge is sparing, and does not readily escape, he recommends an occcasional purgative in less than ordinary quantity. He disapproves of other medicines, especially stimulants, and all such food as is difficult of digestion, giving a general preference to animal food in a gelatinous form. He bestows just praise on strict attention to cleanliness; and, in opposition to Desault and Sabatier, condemns the employment of tents and sponges. (*Op. cit.* p. 371. 373.)

Numerous cases on record furnish abundance of proof that the feces, after being voided for several months from the wound, produced by the operation for hernia, frequently resume their natural course. Facts of this kind, which, in general, may be said to be common when the intestine is without loss of substance, are not very rare even when more or less of the bowel has been destroyed by gangrene; and many illustrations of this remark may be found in the writings of De la Peyronie, Louis, Petit, Pott, Le Dran, &c. Several such cases have fallen under my own observation. The greater number of these instances of success, as already stated, were the result of the most simple unofficious treatment, or rather of the undisturbed and very little assisted efforts of nature.

According to Desault, the most frequent impediment to the restoration of the natural course of the intestinal contents, is the angle formed by the two portions of the intestine; and, says he, it must be enlarged, and rendered less acute, in order that the feces may continue their route. This desirable change he recommends to be effected by introducing long dossils of charpie into the two ends of the bowel, and gradually altering their direction so as to bring it into a straight line. When the dilatation is sufficient, and the inner angle, or ridge, is effaced, the long dossils need not be continued. The linen tent, with the precaution of not introducing it too deeply, lest it obstruct the course of the feces itself, will then suffice. When this plan is skilfully managed, Desault says, there will be a great chance of its succeeding, and its beneficial effect will be denoted by a rumbling in the bowels, and frequently by slight colics. At first, wind is discharged from the rectum, and, soon afterwards, the feces begin to come away. On the contrary, if they should not pass with facility, the colic be violent, and an accumulation happen in the upper portion of the intestinal canal, the tent must be withdrawn, and the other cause of obstruction be considered, and, if possible, removed. (Vol. cit. p. 365, &c.)

In the preceding columns, I have given a full explanation of the impediment made to the passage of the feces into the lower orifice of the intestinal canal, by the projecting septum, or ridge between the two parts of the bowel, and the matter having sometimes to traverse the funnel-shaped membranous cavity in quite a semicircular track. A representation of this septum may be seen in Scarpa's work, tab. 9. fig. 1.; and also in the sixth plate of Mr. Travers's Inquiry. In one example in which this septum was plainly visible in the wound, Dupuytren introduced into the orifice of the upper part of the bowel a curved needle; and, passing it through the projecting septum, brought it out again through the orifice of the lower portion of the gut. Thus, he included a considerable part of the septum in a ligature, which was daily made thicker, with a view of first exciting inflammation in the two layers of this septum, and thus ensuring their adhesion together; and his next plan consisted in making a division through the part embraced by the ligature, whereby the passage for the feces into the lower portion of the bowel was made quite free. But, as the section made by the ligature was too superficial, Dupuytren completed the division of the septum with a knife; but peritonitis and the death of the patient ensued. According to Dr. Breschet, the ligature also proved ineffectual; because its operation was so slow, that adhesions and cicatrization took place behind it as fast as it made its way through the rest of the septum. Hence, the expectation that the feces would sufficiently pass through the aperture made by the ligature was not realised; and, in one case quoted by Breschet, though some amendment followed the operation, still the cure was far from being accomplished, as only some of the feces passed out of the natural anus, while the remaining and greater part of them still came through the fistula. (See *Graefe's Journ.* b. ii. p. 300.; also *Clinique Chir.* t. ii. p. 233.) In another case, Dupuytren tried to render the layers of the septum adherent by compressing them between the blades of a pair of forceps of particular construction; and afterwards he effected the division of the part by augmenting the compression, by means of a screw, traversing the handles of the instrument. In a case which followed the operation for bubonocele, attended with mortification of the bowel, Dupuytren began with dilating the outer opening with a bistoury; and, after ascertaining the position of the septum, between the two orifices of the bowel, he introduced one of the blades of the forceps into each portion of the gut, and closed the instrument with the screw. The part of the instrument, situated externally to the ridge, or septum, he covered with charpie and a compress. The constriction was soon followed by colic pains, and tendency to vomit, complaints which were quickly removed by fomenting the belly. They recurred, however, the instrument became loose, and some discharge ensued. On examination, the septum was found to be partially divided. After the breadth of the instrument had been lessened, it was applied again; but, when the screw was turned, the patient began to suffer such violent pain over the whole of the abdomen, that it was necessary to diminish the pressure; and, as the instrument was afterwards separated from the parts in a fit of vomiting, it was withdrawn. A trial was now made to determine the feces towards the rectum by pressure on the external opening; but the plan could not be endured, and the hinderance to the egress of the intestinal matter was so oppressive, that it was discontinued. As the forceps, used on the foregoing occasion, did not take sufficient hold of the septum, nor divide it properly, the instrument was somewhat altered. A particular description of its improved make has been inserted by Breschet in *Graefe's Journal*, b. ii. p. 302.; and likewise in t. ii. of *Dupuytren's Clinique Chir.* p. 248., where it is termed *l'enterotome.* Dr. Reisinger published three cases, in which it was successfully employed by Dupuytren. In the first of these examples, when the instrument had been applied, it embraced the septum so well, that it could not be displaced from it. The colic attacks, vomiting, thirst, furred tongue, and loss of appetite, which ensued, soon gave way after the belly had been fomented; the constriction was then increased, and found to produce less and less indisposition. On the 29th, very little of the feces came out of the artificial anus; and, after a short time, five natural evacuations took place. The blades of the instrument were now completely closed, and, on taking it out, a slough of membrane was found between the blades; a proof that the septum was destroyed. On the 30th, the patient's health was undisturbed. Clysters were now administered, with the view of promoting evacuations in the natural manner; and, the next day, the patient had a proper motion, without any assistance, and a very small quantity of the feces passed out of the fistulous opening. This aperture was now merely covered with charpie; but, as some high granulations were rising, the power of colophonium was sprinkled upon them, and compresses and a bandage were applied. The use of clysters was also daily continued, though the patient voided his feces in the natural way. On discontinuing the external pressure, the quantity of discharge from the fistulous opening increased;

and therefore, on the 1st of October, the compresses were again applied, and kept on the part with a spring truss. The treatment ended in a perfect cure.

In another case, Dupuytren enlarged the lower angle of the outer opening with a bistoury; and, after feeling with his finger, that both orifices of the bowel were close to that opening, he applied the forceps. In the evening, the constriction was increased, which was followed by severe colic pains over the whole abdomen. They subsided, however, the following day. From the outer opening, a great deal of slimy excrement was discharged. The constriction was not augmented. On the 5th day, the patient was attacked in the night with pain and vomiting. The following night he was also very restless. Though the belly was not tense, it could not bear to be touched. On the 11th and 12th days, the patient was nearly free from pain; and, by means of clysters, two natural motions were procured; and on the 13th, as the patient was easy, Dupuytren began to make pressure on the fistulous opening. On the 26th, the edges of the aperture were touched with lunar caustic; and on the 28th, a compress supported by a spring truss was applied. The patient was kept constantly in the horizontal posture; the feces began to be voided the natural way regularly, and the opening contracted in the most favourable manner.

I think the generality of surgeons will agree with Dr. Reisinger, that the foregoing treatment cannot be indiscriminately adopted, in all descriptions of patients, without danger. It should never be tried too soon after the formation of an artificial anus; but time should be allowed for the irritability and sensibility of the gut, and especially of the septum, to be lessened by the effect of the air and the pressure of the feces. Nor should the trial ever be made ere it has been fully ascertained that nature cannot herself bring about the cure. Breschet mentions an example, in which the foregoing method could not have been practised, in consequence of the mouth of the lower portion of the bowel having been obliterated by the pressure of a large tent, three inches long, which had been worn by the patient two years, and the projecting ridge could not be detected. (See *Graefe's Journ. der Chir.* b. ii. p. 298.) Many other interesting observations on this new proposal may be perused in the memoir by Dr. Breschet, in Dr. Reisinger's tract, the title of which is given in the list of works at the end of the present article, and in *Dupuytren's Leçons Orales*, &c. t. ii. In order not to incur the risk of extravasation of the feces in the abdomen, the constriction of the septum should never be increased with imprudent haste, before the adhesive inflammation has had time to be produced between the two layers, of which that part is composed.

In cases of artificial anus, the appearance of the mucous coat of the bowel undergoes some change, in consequence of exposure to the air and the contact of extraneous bodies; it becomes redder and less villous, but does not cease to secrete a great quantity of mucus: this is one of the principal reasons why it is so difficult to close the fistulous opening, even when the passage for the feces has been restored. The skin, around an artificial anus, is also generally very irritable, and rendered exceedingly painful by the contact of the excrement. (*Breschet*, in *Grarefe's Journ.* b. ii. p. 303.)

The following general directions were given by Dupuytren for the application of his *enterotome*:— 1. The two ends of the bowel must be detected. 2. The septum between them divided. 3. The external opening healed up.

The lower end of the intestine he frequently found very difficult to make out. In old cases, very often neither the angle (éperon), nor the lower portion of the bowel, can be discovered; and it seems as if there was only one passage leading to the fistula. The other, partly obliterated, and retracted within the belly, has an orifice so concealed, that, unless accidentally entered by a probe, its detection is almost impossible. Then the relation of the two portions of intestines to one another, Dupuytren found remarkably inconstant. The stomachic portion, according to the kind of case, may be superior or inferior, external or internal. When the artificial anus communicates with the great intestine, he considers clysters amongst the best means of discovering the orifice of the lower continuation of the intestinal canal. In very difficult cases, he sanctions the use of a plug, purgative clysters, and a very full diet. (See *Clinique Chir.* t. ii. p. 265.)

The two ends of the bowel being ascertained, the operation must not be performed if the mucous coat of the bowels, the peritoneum, or other organs, be the seat of acute or chronic inflammation. The patient is to be prepared by a suitable, mild, antiphlogistic plan.

In the operation the patient is to lie upon his back. The surgeon takes one of the branches of the *enterotome* in the right hand, and guides it, if requisite, with the left forefinger, to one of the orifices of the bowel to the depth of one, two, three, or four inches, according to circumstances. An assistant then takes charge of this first part of the instrument. The other branch is then introduced into the other end of the bowel in the same manner. Both branches are then brought together, and joined like a pair of forceps. The blades are then made to grasp the bowel by pressing the handles together. The pressure is next regulated and maintained by means of a screw. Before the expiration of the first day, the pressure is to be increased sufficiently to kill the portion of intestinal tunics embraced by the instrument; and the pressure is to be again augmented every second day, to render their destruction still more certain. In the cases under Dupuytren, the instrument was detached between the seventh and tenth day, bringing away with it the destroying jutting angle and septum, which prevented the upper portion of bowel from communicating with the lower. Frequently the first signs of the re-establishment of the natural passage precede the detachment of the enterotome. In all cases, slight colic occurs, the evacuations are at first white and albuminous from the lower bowels, and these are followed by stercoraceous matter from the upper ones. At first they are numerous and liquid, and attended with gripings; but they soon become of proper quality, and all uneasiness subsides. (See *Dupuytren*, in *Clin. Chir.* t. ii. p. 264, &c.)

If, after the destruction of the septum, and the re-establishment of a free communication between the two portions of the bowel, the external fistula were not to admit of being healed by pressure and other ordinary means, no doubt could be entertained of the propriety of resorting to the plan of attempting to cure it by paring off the edges and bringing them together with sutures, as was sometimes done by Dupuytren; or on the Taliacotian principles, as successfully exemplified by Mr. G. F. Collier. (See *Med. and Physical Journ. for June*, 1820.) Dupuytren, for the purpose of making the sides of the fistula remain in contact, or making them approach each other, occasionally applied an ingenious little instrument, consisting of two pads, which, by means of a screw, can be made to embrace the part. An engraving of it may be seen in *Graefe's Journ.* b. iii. taf. 3. fig. 9. For the closure of the fistula, Dupuytren also sometimes had recourse to a truss, and now and then to the actual cautery.

If after the contraction, or perfect closure of the external opening, the patient should be attacked with colic, nausea, vomiting, and other symptoms of retention of the intestinal matter; and these complaints were not to yield to diluent drinks, aperient injections, and fomentations, Dupuytren recommends making a prompt incision through the cicatrix, and forming a free outlet for the matter accumulated above it. (See *Clinique Chir.* t. ii. p. 272.)

I shall conclude with the relation of an interesting case of artificial anus, complicated with prolapsus, as recorded by my friend Mr. Lawrence.

"If the complaint (a mortified hernia) terminates in the formation of an artificial anus, we must endeavour to alleviate those distressing inconveniences, which arise from the involuntary discharge of wind and feces through the new opening, by supplying the patient with an apparatus, in which these may be received as they pass off. An instrument of this kind, the construction of which appears very perfect, is described by Richter (*Anfangsgr. der Wundarzn.* vol. v.), from the *Traité des Bandages* of Juville. The patient will be best enabled to adapt any contrivance of this sort to the particular circumstances of his own case. It has been found, in some instances, that a common elastic truss, with a compress of lint under the pad, has been more serviceable than any complicated instrument (*Parisian Journ.* vol. i. p. 193.) in preventing the continual flow of feculent matter from the artificial opening." (*Treatise on Hernia*, p. 206.)

"I know," says Mr. Lawrence, "a patient with an artificial anus, in whom the gut often protrudes to the length of eight or ten inches, at the same time bleeding from its surface. This is attended with pain, and compels him to lie down; in which position the intestine recedes. The patient has now discharged all his feces at the groin for fifteen years; and has enjoyed tolerable health and strength during that time. His evacuations are generally fluid; but sometimes of a natural consistence. Whenever he retains his urine, after feeling an inclination to void it, a quantity of clear inoffensive mucus, like the white of an egg, amounting to about four ounces, is expelled from the anus; and this may occur two or three times in the day." (P. 208.)

When the protruded intestine is strangulated, an operation may become necessary for the removal of the stricture. (*Schmucker, Vermischte Chirurgische Schriften*, t. ii.) Two cases, which terminated fatally from this cause, are mentioned by Sabatier, in a memoir in the 5th tom. de. l'Acad. de Chir. Mr. Lawrence also refers to Le Blane. (*Précis d'Opérations de Chir.* tom. ii. p. 445.) We should always endeavour to prevent such protrusions, when a disposition to their formation seems to exist, by the use of a steel truss, which should, indeed, be worn by the patient, independently of this circumstance. If the tumour has become irreducible by the hand, an attempt may be made to replace it by keeping up a constant pressure on the part, the patient being at the same time confined to bed. By these means, as we have already noticed, Desault (*Parisian Journ.* vol. i. p. 178.) returned a very large prolapsus; and by pressure on the opening, the feces were made to pass entirely by the anus, although for four years they had been voided only through the wound. (*Lawrence*, p. 209, 210.)

In cases of mortified hernia, the wound sometimes closes, except a small fistulous opening, which discharges a thin fluid, and cannot be healed. Mr. Lawrence has related, in his excellent treatise on hernia, a case in which the feces came from the wound some time after an operation, although the bowel did not appear gangrenous when this proceeding was adopted. (P. 211.)

In the appendix to this work, the author adds some further account of the case of artificial anus, which he has related. (P. 208.) The man is sixty years of age, and appears to be healthy, active, and even younger than he really is. He had had a scrotal hernia, which ended in mortification, and involved the testicle of the same side, and a large portion of the integuments, in the destruction. It is now nearly seventeen years since this event, and the feces have, during all this time, been discharged from the groin. He has never made use of a truss, nor taken any step, except that of always keeping a quantity of tow in his breeches.

The prolapsed portion of intestine varies in length and size at different times. It was four inches long when Mr. Lawrence saw it, and the basis, which is the largest part, measured nearly six inches in circumference. The prolapsus never recedes entirely, but it has occasionally protruded to the length of eight or ten inches, being as large as the forearm, and emitting blood. This occurrence is painful, and only comes on when the bowels are out of order. Warm fomentations and a recumbent position afford relief, and accomplish a reduction of the bowel.

The projecting part is of a uniform red colour, similar to that of florid and healthy granulations. The surface, although wrinkled and irregular, is smooth and lubricated by a mucous secretion. It feels firm and fleshy, and can be squeezed and handled without exciting pain. The man has not the least power of retaining his stools. When these are fluid, they come away repeatedly in the course of the day, and with considerable force. When of a firmer consistence, there is only one stool every one or two days, and the evacuation requires much straining. Such feces are not broader than the little finger. When the patient is purged, the food is often voided very little changed. This is particularly the case with cucumber. In this state, he is always very weak. Ale is sometimes discharged five minutes after taken, being scarcely at all altered. The bowels are strongly affected by slight doses of purgatives.

J. R. Tieffenbach, Vulnerum in intestinis lethalitas occasione casus rarissimi, quo colon vulneratum, inversum per 14 annos ex abdomine propendens exhibetur. *Halleri*, Disp. Chir. 5. 61. *Desault*, in Parisian Chir. Journal, vol. i.; or Œuvres Chirurg. par *Bichat*, t. ii. p. 352. &c. *Schmucker's* Chir. Schriften, vol. ii. *Smalkalden*, Nova Methodus Intestina uniendi. Viteb. 1798. *Callisen*, Systema Chirurgiæ Hodiernæ, t. ii. p. 710. &c. Sull' Ernie Memorie Anatomico Chirurgiche, fol. Milano, 1809. *B. Travers*, Inquiry into the Process of Nature in repairing Injuries of the Intestines, chap. viii. 8vo. Lond. 1812. *Dorsey's* Elem. of Surgery. Philad. 1823. *F. Reisinger*, Anzeige einer von dem H. Professor Dupuytren erfundenen, und mit dem glücklichsten Erfolge ausgeführten Operationsweise zur Heilung des Anus Artificialis, nebst Bemerkungen, Augsburg, 1817. *Baron Dupuytren*, Mém. sur une Méthode Nouvelle pour traiter les Anus accidentels, lu à l'Acad. des Sciences en Janvier, 1824; Dans la Collect. des Mém. de l'Acad. Roy. de Méd. 4to. Paris, 1828; also, in Leçons Orales de Clin. Chir. t. ii. 8vo. 1832; also, in Dict. de Méd. et de Chir. Pratiques, t. iii. art. "Anus contre Nature." Professor Delpech invented forceps which first took hold of the septum, between the two portions of the bowel, and then divided it by means of two little knives, which, on touching a spring, glided along the interior of the blades, and met towards their end. A representation of it may be seen in *Froriep's* 268th plate, fig. 4. The plan of cutting the septum, however, is abandoned, as likely to cause effusion of the contents of the intestinal canal, and peritonitis. *Lallemand*, in Répertoire Gén. d'Anat. &c. rédige, par G. Breschet, t. vii. 1823. *Casamajor*, Obs. d'un Anus contre Nature ouvert dans le Vagin; Journ. Hebdom de Méd. t. iv. p. 163. 1829. *Sabatier*, in Mém. de l'Acad. de Chirurgie, t. v. 4to.; and Médecine Opératoire, t. ii. ed. par MM. Breschet, Sanson, et Béguin. *Brosse*, in Rust's Magazine, b. vi. p. 239. *Liordat*, Dis. sur le Traitement de l'Anus contre Nature, Paris, 1819. *Hennen's* Military Surgery, p. 407, &c. ed. 2. Edin. 1820. Three cases from gunshot wounds; the cure effected by aiding nature occasionally with the exhibition of laxatives and clysters. *Breschet*, in Journ. der Chirurgie von C. F. Graefe, und Ph. von Walther, b. ii. p. 273. 479. Berlin, 1821.

Fissures of the Anus.

As they are termed, consist of longish superficial ulcerations near the anus, between the converging folds of the fine skin and mucous membrane. When the sides of the anus are separated, and the patient is desired to strain, a narrow fissure is seen, the bottom of which is red, and the margins somewhat swollen and callous. But, as Dupuytren observes, it is frequently necessary, for the purpose of ascertaining how high it reaches, to introduce the finger into the rectum. It is more commonly situated at the sides and back of the anus, than at the fore part of it; a favourable circumstance in relation to an operation, particularly in women, in whom this opening is divided from the posterior commissure of the vulva only by a thin partition. The ulceration rarely affects the whole thickness of the mucous membrane. (See *Dupuytren, Clinique, Chir.* t. iii. p. 283.) Fissure of the anus is usually productive of violent lancinating or burning pain, which gradually augments, and lasts a considerable time after the patient has had a motion. In some cases, indeed, so extreme is the suffering, that the patient from a dread of obeying the call of nature, refuses, as long as possible, or even nearly starves himself, to render the occasions for emptying the rectum less frequent. The severity of the case arises chiefly from a painful spasm of the sphincter muscles.

Constipation, and the spasm which it excites, are amongst the predisposing causes of fissure of the anus. The indurated fecal matter, either by causing ulceration of the mucous membrane, or by immoderate distention of the passage, may bring on the complaint. The unskilful administration of clysters, especially with pointed rough pipes, is often the cause. Fissures of the anus are frequently met with in persons who have piles; and according to Dupuytren, the lodgment of venereal matter near the anus, as happens in many women, may lead to the complaint. Perhaps it would be more correct to say, that the contact of any irritating matter, or secretion, may have this effect.

According to Dupuytren, the spasmodic constriction of the sphincter is the real disorder, and the fissure is only a secondary effect. By putting a stop to this constriction, the disease is cured. With this view, Dupuytren tried what good could be done by the following application: ℞. Axungiæ ʒvj., extr. belladonnæ plumbi acetatis ā ā ʒj. Misc. A tent of linen or charpie, or, as I should say, a soft rectum bougie, of moderate size, smeared with this ointment, is introduced, and its diameter gradually increased to that of the forefinger. Dupuytren states, that the continuance of this treatment for a few days frequently relieves the pain entirely, and obviates all necessity either for caustic, or the division of the sphincter. Even when the plan does not cure, it always palliates, and therefore should be tried before the latter methods are resorted to.

Baron Dupuytren makes a very useful and practical division of fissures of the anus, into three kinds. *Some are below the sphincter*, affecting hardly any texture but the skin, and not the mucous membrane. These excite more or less pruritus, but cause little obstruction to the passage of the feces. *Fissures above the sphincter*, involving the mucous membrane, can only be seen with the aid of a speculum. When the finger is passed into the rectum, a knotty hard chord is felt, and pressure on it creates acute pain. When the patient goes to stool, such fissures give rise to an indescribable sort of tenesmus, which ceases directly after the evacuation; and the excrement on the side nearest the disease, is covered with puriform or mucous, bloody fluid. Such fissures were found by Dupuytren to be commonly produced by the ulceration of internal piles, excited by the passage of indurated fecal matter. Lastly, fissures *on a level with the sphincter*, are the worst, being attended with agonising constriction of the sphincter, and other symptoms already specified.

The two first descriptions of fissure may mostly be cured without any operation; some by the dressing them with simple cerate, or ointment containing opium, mercurial preparations, &c.; others by emollient anodyne lotions or applications. But where the fissure was of the third description, Dupuytren considered the operation first introduced by Boyer the quickest and surest means of cure. This consists in dividing the anus and sphincter with a probe-pointed bistoury, passed into the rectum, and cutting directly through the fissure, except when it lies forward towards the vagina in the female, or urethra in the male subject. When several fissures existed, Dupuytren sometimes made several cuts in different directions, from three to four lines deep. (See *Clin. Chir.* t. iii. art. 10.)

Preternatural Contraction of the Sphincter.

Sir Benjamin Brodie has treated of this as a distinct affection; and, indeed, we find that Dupuytren represents it as being generally the primary complaint in fissure of the anus. The cases, referred to by the former gentleman, he has met with chiefly in women disposed to hysteria; though sometimes in the male sex. In emptying the rectum, the patient is obliged to strain very much, especially when the feces are solid; then pain is experienced, which lasts a considerable time afterwards. Very often a small ulcer of the mucous membrane of the rectum (the second variety of Dupuytren's fissure) accompanies spasmodic contraction of the sphincter, and is always, according to Sir Benjamin Brodie's description, situated at the posterior part, opposite the point of the os coccygis. When the suffering is not excessive, relief may sometimes be derived from purgatives, given to prevent the evacuations from being hard and figured, from an opiate suppository at night, and from the introduction of a bougie into the anus just before the patient has a motion. In worse cases, Sir Benjamin Brodie recommends the division of the sphincter with a straight probe-pointed bistoury. The fibres of this muscle are thick, and will require two or three strokes for their complete division. An opiate may be given to keep the bowels quiet for two or three days afterwards. Then a dose of castor oil may be exhibited. Simple dressings will suffice to heal the wound. (See *Brodie* in *Lond. Med. Gaz.* for 1834, 1835, p. 26.)

Excrescences of the Anus.

These cases are frequent, the growths receiving a variety of names, according to their supposed resemblance to things, as condylomata, mariscæ, and fici. Some are much firmer than others; some of them grow, in consequence of irritation of the skin of the anus, by the contact of rancid secretions, or purulent matter. Others are originally piles; for, as Sir Benjamin Brodie observes, when the cavities of external piles become obliterated, they generally form flaps of skin, which gradually waste; but sometimes diseased action takes place in them, and they become converted into excrescences, similar to those which grow from the nymphæ of women. Many excrescences about the anus and perineum are of middling consistence, between that of a wart and that of a polypus. I have cured a great number by stimulating applications, as the nitrate of silver, the tinc. ferri mur., the acetic acid, and the powder of savine, blended with subacetate of copper, or a solution of the sulphate of copper. When their necks have been narrow, I have also extirpated many of them with ligatures. But, in general, I remove the larger kinds with a bistoury. The bleeding, which may be at first copious, does not generally require a ligature, as it stops as soon as lint or linen dipped in cold water, and a T bandage have been applied. (See Hemorrhoids and Rectum.)

AORTA. Aneurisms of this vessel have already been treated of: but some other particulars, relating to it, merit notice in a dictionary of surgery.

Wound of the Aorta not always followed by instantaneous Death.

A case, exemplifying this fact, was recorded by M. Pelletan. In the month of May, 1802, a young man was brought to the Hôtel Dieu. In a duel, he had been run through with a foil, which penetrated above the right nipple, and came out at the left loin. The most alarming symptoms were apprehended; but several days elapsed without any serious complaints taking place. The patient was bled twice, and kept on a very low regimen. Every thing went on quietly for a fortnight. He now complained of severe pains in his loins, and he was relieved by the warm bath. He seemed to be recovering, got up, and went to walk in the garden allotted for the sick; but the pain in his loins quickly returned, attended with difficulty of breathing, constipation, and wakefulness. He now became very impatient, and out of temper with the surgeons for not relieving him.

On the 15th of July, two months after the accident, a deformity of the spine was remarked, about the eighth dorsal vertebra. The patient grew rapidly worse, and died in the utmost agony, saying that he felt suffocated; and tearing off his shirt that his chest might be free from the pressure of all kind of clothing.

On the body being opened, the right side of the chest was found full of blood, coagulated in various degrees; and an opening, the diameter of which was equal to that of a writing pen, was detected in the aorta above the crura of the diaphragm. All the adjacent cellular substance was injected with blood, and three of the dorsal vertebræ were found carious. No mark of injury was perceptible in any of the thoracic or abdominal viscera. (*Pelletan, Clinique Chir.* t. i. p. 92—94.)

Thickening and Constriction of the Aorta.

Meckel met with two cases, in which the aorta was thickened and considerably constricted, just below its arch; yet, in both subjects, there was every reason to believe that the abdominal viscera and lower extremities had been duly supplied with blood. This fluid, which could only pass from the heart with great difficulty, and in small quantities, had, by regurgitating, lacerated the semilunar valves. (*Mém. de l'Acad. Royale de Berlin,* 1756 Obs. 17 and 18.) A similar example is recorded by Stoerck. (*Ann. Méd.* xi. p. 171.) An instance, in which a stricture was met with in the aorta, opposite to the termination of the canalis arteriosus, is described by Sir Astley Cooper. The little finger could hardly pass through the constriction, which impeded the course of the blood through the heart and lungs, and was attended with a considerable dilatation of the right ventricle. (*Surgical Essays,* vol. i. p. 103. 8vo. Lond. 1818. For other facts of this kind, see *Bertin et Bouilland, Traité des Mal. du Cœur et des gros Vaisseaux, Reynaud,* in *Journ. Hebdom. de Méd.* t. i. &c.) Gangræna senilis is sometimes connected with disease and morbid deposits within the aorta. (See *Carswell's Illustrations of the Elem. Forms of Disease,* fasc. 7. pl. 3. fig. 2.) See Mortification.

Obliteration of the Cavity of the Aorta.

It is observed by Professor Scarpa, that the whole body may be regarded as an anastomosis of vessels, a vascular circle; and he contends that this remark is so true, that even an obliteration of the aorta itself, immediately below its arch, may take place, without the general circulation of the blood in the body being stopped. Such a disease of the aorta was seen by M. Paris in the body of a woman. While she lived, the blood, which was expelled from the heart, was transmitted into the trunk of the aorta, below the constriction; and it got there by passing through the subclavian, axillary, and cervical arteries into the mammary, intercostal, diaphragmatic, and epigastric arteries. From these latter arteries, the blood passed into the vessels of the thoracic and abdominal viscera, and those of the lower extremities. (See *Desault, Journal*, t. ii. p. 107.; *Brasdor*, in *Recueil Périodique de la Soc. de Méd.* t. iii. No. 18.) Another instance of complete obstruction of the aorta was met with by Monro. (See *Obs. on Aneur. of Aorta*, p. 5.) Dr. Graham, of Glasgow, published another example, in which the aorta was completely obstructed just below the canalis arteriosus. (See *Med. Chir. Trans.* vol. v. p. 287.)

Dr. Goodison, of Wicklow, in examining the dead body of a woman, in the Hospice de la Pitié, at Paris, and endeavouring to trace the origin of the inferior mesenteric artery, discovered a hard tumour placed upon the aorta, and accompanied with an obliteration of that vessel from the origin of the inferior mesenteric artery downwards the remainder of its length; the left iliac being also rendered impervious down to its bifurcation, and the right for more than one half of its length. The corpora sesamoida of the semilunar valves of the aorta were considerably enlarged, and the mitral and tricuspid valves presented the appearances termed by Corvisart "vegetations." The arch of the aorta was greatly enlarged, and internally was studded with patches of bone. The vessels given off from the trunk, and especially the lumbar arteries, were all noticed to be considerably increased in size. At the obliterated part of the abdominal aorta, there was a firm bony sheath, covering the vessel for about two inches, and filled with a hard fleshy substance, which extended further upwards, and was firmly adherent to the coat of the artery. It was the inner coat itself which was ossified. For a particular account of the vessels, which were chiefly enlarged for the purpose of continuing the circulation, I must refer to Dr. Goodison's description. The general appearance of the body was not unhealthy; and the lower extremities, which were not emaciated, must have been well supplied with blood. The history of the case could not be traced. Mr. Crampton, having carefully compared Dr. Goodison's narrative with the preparation taken from this subject, refers the obliteration of the aorta to the effects of the process by which an aneurism had been spontaneously cured; in which particular, this case is quite different from those reported by M. Paris and Dr. Graham. (See *Dublin Hospital Reports*, vol. ii. p. 193, &c. 8vo. 1813.)

The foregoing cases prove, that the obliteration of the canal of the aorta, at any one part, is not incompatible with the continuance of life; and suggested the possibility of the application of a ligature to it being the means of sometimes saving the patient from the doom of certain death.

The next case, which I shall notice, is one of the most memorable in the annals of surgery, since it was nothing less than an operation, in which a ligature was applied, for the first time to the aorta of a living subject, under circumstances which, at a time when the successful repetition of Brasdor's operation had not been made (see *Wardrop on Aneurism*, 1829), perhaps warranted even this desperate attempt to preserve life. Sir Astley Cooper had often placed ligatures round the aorta in dogs, and found that the blood was readily carried by the anastomoses to their posterior extremities (see *Med. Chir. Trans.* vol. ii. p. 158.); and he has ascertained, that if the aortic plexus be tied with the artery, the lower extremities are rendered paralytic, and the animal ultimately dies; but, if care be taken to include only the vessel in the ligature, these consequences do not take place. (See *Lancet*, vol. ii. p. 47.)

A porter, aged thirty-eight, was admitted into Guy's Hospital, April 9, 1817, for an aneurism in the left groin, situated partly above, and partly below, Poupart's ligament. The swelling was considerably diffused, and pressure upon it gave a great deal of pain. On the third day from his entrance into the hospital, the tumour increased to double its former size, and the pulsation became less distinct. The blood could be felt in a fluid state within the sac, which was so large that no operation was practicable, without opening the peritoneum. Sir Astley Cooper therefore waited, in order to let the man have the chance of a spontaneous cure. Notwithstanding the practice of venesection and compression, the swelling continued to increase, and, on the 20th of June, a bleeding took place from a point of the tumour, where a slough had formed. The bleeding recurred from time to time; and on the 25th he was so much exhausted by loss of blood, that his feces passed involuntarily, and his immediate death was only prevented by pressure on the opening. At nine o'clock in the evening, this experienced surgeon made a small incision into the sac above Poupart's ligament, and introducing his finger, tried if it were practicable to pass a ligature round the external iliac artery within the cavity; but the thing was found impossible, as, instead of the vessel, "only a chaos of broken coagula" could be perceived. At the moment of withdrawing the finger, two students compressed the aorta against the spine, and the incision was then closed with a dossil of lint. Sir A. Cooper now determined to apply a ligature to the aorta itself. "I made (says he) an incision, three inches long, into the linea alba, giving it a slight curve to avoid the umbilicus. One inch and a half was above, and the remainder below the navel," the cut being inclined towards the left side. "Having divided the linea alba, I made a small aperture into the peritoneum, and introduced my finger into the abdomen; and then, with a probe-pointed bistoury, enlarged the opening in the peritoneum to nearly the same extent as that of the external wound. Neither the omentum nor the intestines protruded; and during the progress of the operation, only one small convolution projected beyond the wound." With his finger-nail he scratched through the peritoneum, on the left side of the aorta; and then gently moving his finger from side to side, he gradually passed it between the aorta and spine, and again penetrated the peritoneum on the right side of the aorta. A blunt aneurismal needle, armed with a single ligature, was next conveyed under that vessel, and tied, with the precaution of excluding the intestines from the noose. The wound was then closed by means of the quilled suture and adhesive plaster. During the operation, the feces were discharged involuntarily, and the pulse, both immediately and for an hour after the operation, was 144. An opiate was given, and the involuntary passage of feces soon ceased. The sensibility of the right leg was very imperfect. In the night the patient complained of heat in the abdomen; but he felt no pain upon pressure; and the lower extremities, which had been cold a little while ~~after the~~ operation, were regaining their heat, but their sensibility was very indistinct. At six o'clock the following morning, the sensibility of the limbs was still imperfect; but at eight o'clock the right one was warmer than the left, and its sensibility returning. At noon, the temperature of the right limb was ninety-four; that of the left, or aneurismal one, eighty-seven and a half. At three o'clock, an enema was ordered. The heat of the right leg was now ninety-six; that of the left or diseased limb, eighty-seven and a half. It is unnecessary, here, to detail all the various circumstances which preceded the patient's death. Vomiting, pain in the abdomen and loins, involuntary discharge of urine and feces, a weak pulse, cold sweats, &c., were some of the most remarkable symptoms. At eight o'clock on the second morning after the operation, the aneurismal limb appeared livid and cold, more particularly round the aneurism; but the right leg was warm; and between one and two o'clock the same day, the patient died. On opening the abdomen, there was not the least appearance of peritoneal inflammation except at the edges of the wound; and the omentum and intestines were of their natural colour. The ligature, which included no portion of intestine or omentum, was placed round the aorta, about three quarters of an inch above its bifurcation. When the vessel was opened, a clot, of more than an inch in extent, filled it above the ligature; and below the bifurcation another clot, an inch in extent, occupied the right iliac artery, while the left contained a third, which extended as far as the aneurism. The neck of the thigh-bone was also found broken within the capsular ligament, and not united; an accidental complication. As there were no appearances of inflammation of the viscera, Sir Astley Cooper refers the cause of the man's death to the want of circulation in the aneurismal limb, which never recovered its natural heat, nor any degree of sensibility, though the right leg was not prevented from doing so; hence, says this experienced surgeon, "in an aneurism similarly situated, the ligature must be applied before the swelling has acquired any very considerable magnitude." (*Surgical Essays*, vol. i. p. 114, &c.)

Indeed, the most important conclusions, from this case are: — First, that where no other impediments exist, the circulation will continue in the lower extremities, though the abdominal aorta be tied, or suddenly obstructed. Secondly, that suffering aneurismal swellings to become very large, before the operation is done, exposes the patient to considerable disadvantage, on account of the pressure of the disease upon the surrounding anastomoses, whereby the continuance of the circulation is rendered less certain, than it would be, were the operation done at an earlier period.

Sir Astley Cooper mentions, that if he were to perform the operation again, he would cut off the two portions of the ligature close to the knot on the vessel; because the irritation of the bowels by them seems to him a source of considerable danger. He has also said, that if a case like the foregoing should again occur to him, he would seek the aorta behind the peritoneum. (See *Guthrie on Dis. of the Arteries*, p. 363.) Whoever has practised the operation of tying the common iliac artery on the dead subject, must be fully aware of the practicableness of this last method: in my friend Mr. James's case, however, which I am about to notice, he found the peritoneum so firmly adherent to the aneurismal sac, that he says that it would have been absolutely impossible to have detached them from one another; and the method of operating, therefore, without opening the peritoneum, could not have been followed. (*James*, in *Med. Chir. Trans.* vol. xvi. p. 15.) In a third example, however, of ligature of the aorta, where Dr. Murray was the operator, the latter plan was executed, "without more difficulty than was to be anticipated." The patient died twenty-three hours after the operation. (See *Lond. Med. Gaz. for* 1833, 1834, p. 68.)

Mr. James, of Exeter, had a patient with an aneurism of the external iliac artery, situated so high up that the vessel could not be tied above the tumour. Brasdor's operation seemed to Mr. James the only feasible one; and he determined to try it, notwithstanding the total absence of pulsation in the groin raised a doubt whether the stream of blood was not altogether intercepted. Such want of pulsation Mr. James himself did not regard as a proof of want of circulation. "Having measured exactly half the distance between the spine of the ilium and the symphysis pubis," says Mr. James, "I made an incision over this point from a little above Poupart's ligament to about three inches down the thigh. A large gland then presented itself, which was dissected to the inside: underneath this the crescentic edge of the fascia lata was visible, which I also divided. I then proceeded, chiefly with my fingers and nails, to separate the parts till I reached the sheath of the vessels, which was at a considerable depth. This I scratched through with a silver knife, and bared the artery, under which I passed Weisse's needle, and tied it about half an inch below Poupart's ligament." (See *Med. Chir. Trans.* vol. xvi. p. 3.) Some diminution of the tumour at first took place; but, on the third day, it began to increase again; and, in about three weeks, the integuments had a tense shining appearance, and afterwards a dusky-red œdematous look, denoting that sloughing could not be remote. The increase of the tumour towards the umbilicus appeared to Mr. James also to render some step necessary without delay. After a consultation with Dr. Miller, Mr. Luscombe, Mr. Barnes, Mr. Harris, and other practitioners, it was therefore decided to tie the aorta. Mr. James began the external incision an inch above the umbilicus, and extended it down to two inches below it. After the peritoneum had been opened, great embarrassment was occasioned by the protrusion of the distended bowels. The handle of the aneurism-needle broke at the moment the instrument was passed under the aorta. "The broken part was so sharp," says Mr. James, "that I was obliged to withdraw it for fear of injuring the intestines. With some additional difficulty I got my finger, with Weisse's instrument upon it, under the artery; but, even after this had been effected, it was by no means easy, with the best assistance of my colleagues, to extricate the short needle bearing the ligature, so much did the intestines interfere with every kind of manipulation. When the ligature was underneath, I kept the intestines out of the way with the fingers of both my hands, and placed one of my thumbs on the vessel, whilst Mr. Luscombe drew it (the ligature) first on my thumb, and then on the artery." The tumour immediately became flaccid, and a deadness in the lower extremities was complained of. We shall only add, that the patient afterwards suffered severe pain in the lower limbs, which never ceased till he died, which event took place three hours and a half after the operation. During this short time, the temperature of the lower limbs was equal to that of the trunk; but it fell in every part of the body. The particulars of the *post mortem* examination are interesting; but I can only state here, with reference to Brasdor's operation, that "the external iliac artery did not terminate in the femoral, as usual, but gave off two trunks of nearly equal size; and from the inner, which corresponded with the profunda, the epigastric was given off." Mr. James does not regard then the result of his attempt as unfavourable to Brasdor's method; "for a considerable and satisfactory alteration was produced by tying only one of the trunks which led from the iliac, and had the distribution been natural, it is not improbable," says he, "a cure would have been obtained." (See *Med. Chir. Trans.* vol. xvi. p. 14.)

On this subject I find the following observations made by my friend Mr. Crosse: — "I meet yearly with recorded instances of a portion of the aorta being entirely obliterated, and the accounts of such cases are often followed by a word of encouragement to repeat the application of a ligature to this vessel. Astley Cooper, James, and Murray, are the only names associated with this undertaking; and its intrepid originator allows me to say, that he would not repeat the operation, except under an improved and a more safe plan of conducting it; approaching to the sentiments of a recent writer, who sums up a full consideration of the subject by remarking that *the operation ought not to be again performed*." (*Crosse*, in *Provincial Med. and Surgical Trans.* vol. v.) I am disposed to be of this opinion myself; and, at all events, believe with Mr. Guthrie, that the ligature of the aorta may be in almost every instance superseded by that of the common iliac artery. I think also with him, that if the operation ever succeed, it will be when the aorta is taken up by passing the finger under the peritoneum, along the common iliac artery, up to that vessel. (See *Guthrie, Op.* cit. p. 372.)

For tying either the aorta, the common iliac, or the internal iliac artery, Mr. Guthrie gives some directions for computing the point at which the artery is to be tied, in relation to the umbilicus and the anterior superior spinous process and the crest of the ilium. "The aorta," he observes, "bifurcates usually on the body of the fourth, or on the intervertebral substance between it and the fifth vertebra, although it may be higher or lower, which cannot be ascertained previously to the operation; and the most usual place is nearly opposite to the margin of the umbilicus on the left side. It is about half an inch above this that the ligature should be placed on the aorta, and rather lower than higher, on account of the origin of the inferior mesenteric artery. As the aorta is to be reached by carrying the finger along the common iliac, the comparative situation of that vessel is next to be estimated." (See *Guthrie on Dis. of the Arteries*, p. 368.) He afterwards observes, that the left margin of the umbilicus being taken as a point opposite to that which may be presumed to be the part at which the aorta divides, and the situation of the external iliac becoming femoral being clearly ascertained, a line drawn between the two will indicate the course of these vessels sufficiently to enable the operator to mark with his eye the place where he means to tie the artery, and to regulate the length of the incision, so that this ideal spot may correspond to the centre of it. If a ruler be placed on the crest of each ilium, about one inch and a half behind the anterior superior spinous process, it will pass across the junction of the fifth lumbar vertebra with the sacrum, and a little way behind the point where the common iliac divides into external and internal. The centre of an incision five inches in length, beginning about half an inch above Poupart's ligament, and about the same distance to the outside of the inner ring, and carried upwards, will fall nearly on a line with this point. Mr. Guthrie prefers an incision nearly parallel to the course of the epigastric artery, but a little to the outside of it, with a gradual inclination inwards towards the external edge of the rectus. The several layers of the abdominal muscles having been cautiously divided, and the fascia transversalis torn through, the fingers are passed outwards towards the ilium, and the peritoneum detached from the iliac fossa, and turned with its contents inwards. At the inner edge of the psoas muscle, the pulsations of the external iliac artery are then felt. "It is then to be traced upwards and inwards towards the spine, where the origin of it and the internal iliac from the common iliac trunk will be felt. The point of the forefinger will then be nearly in the centre of a line, drawn from the umbilicus to the anterior superior spinous process of the ilium; and hence the necessity for an incision five inches in length, if the artery is to be tied high up, which is to be accomplished by tracing it in a similar manner to its origin from the aorta." (See *Guthrie, Op.* cit. p. 371.) The aorta itself may be tied by the same method, the only difference being an extension of the incision further upwards, so as to make its length six inches. (P. 372.)

Rupture of the Aorta within the Pericardium.

The surgical writings of Scarpa, in relation to the formation of aneurisms, have now gained extensive celebrity in the world. It is well known that this author maintains the doctrine, that, in all aneurisms, the internal and muscular coats of the artery are ruptured; and that the aneurismal sac is not formed of these tunics, but of the dilated cellular sheath which surrounds the vessel. When a large aneurism bursts, there is always a double rupture; one of the artery, another of the aneurismal sac. The last is that which is the immediate cause of the patient's destruction, by altering the *circumscribed* state of the aneurism into the *diffused*.

There are some exceptions, however, to the foregoing statement; and Scarpa has not failed to point them out. When the internal and muscular coats of the aorta are ruptured in a situation, where the outside of the vessel is only covered by a thin, tense, closely adherent membrane, such membrane may be ruptured at the same time with the proper coats of the artery, and sudden death be occasioned by the effusion of blood in the cavity of the thorax. These events are liable to happen whenever the proper coats of the aorta are ruptured within the pericardium, where the vessel is only covered by a thin layer reflected from this membranous bag. Walther has recorded one example of this kind, and Morgagni several others. A similar case is related by Scarpa. Several specimens are contained in the museum of the London University. (See *Haller, Disput. Chir.* tom. v.; *Acta Medic. Berlin,* vol. viii. p. 86.; *Morgagni, De Sed. et Causis Morb.* Epist. xxvi. art. 7. 17. 21., Epist. xxvii. art. 28.; *Scarpa on Aneurism, transl. by Wishart,* p. 81. Also *Hodgson on the Diseases of Arteries and Veins.*)

Steatomatous Tumours of the Aorta.

Two steatomatous tumours were noticed by Stenzel in the body of a male subject. They were situated in the substance of the membranes of the aorta, immediately below its arch. Notwithstanding these swellings had rendered the vessel almost impervious, the man had the appearance of strength, and of having been well nourished. *Hæc corpora fere cor magnitudine æquabant ut omnem propemodum exeunti e sinistri cordis thalamo sanguini spatium præcluderent.* De Steatomatibus in principio arteriæ aortæ, &c. Wittemb. 1723. This is another striking fact, illustrating the great power of the inosculations to carry on the circulation.

Compression of the Aorta,

In order to restrain hemorrhage from the inferior half of the body, more especially from the uterus, has been warmly advocated, and in thin persons, seems calculated to be beneficial. (See *Crosse, Provincial Med. and Surgical Trans.,* vol. v.) I have mentioned the adoption of this plan by Sir Astley Cooper, in the case where he opened the aneurismal sac, previously to putting a ligature on the aorta.

APHÆRESIS (from ἀφαιρέω, to remove). A term formerly used in the schools of surgery, to signify that part of surgery which relates to the removal of any portion of the body.

APONEUROSIS. Matter often collects under aponeuroses, particularly under those which cover the muscles of the thigh, leg, and forearm. Abscesses are also sometimes met with under the temporal, the palmar, and the plantar fasciæ; in the tendinous thecæ, which include the flexor tendons of the fingers; and, occasionally, also in the aponeurotic sheath, in which the rectus abdominis muscle is situated.

One particular effect of an aponeurosis, or fascia, lying between a collection of matter and the skin, is materially to retard the progress of the pus towards the surface of the body. Hence, if the case be allowed to take its own course, the quantity of matter increases; the pus spreads extensively under the aponeurosis in every possible direction; separates the muscles from such fascia, and the muscles from each other; and the abscess does not burst till a vast deal of mischief has been produced, together with more or less sloughing of the fascia, tendons, &c. These circumstances cannot happen without a considerable degree of constitutional disturbance, and a permanent loss of the use of certain muscles. Even when a spontaneous opening is formed, and some of the matter escapes, it is often only a very imperfect discharge; for the aperture generally occurs, not in a depending situation, nor over the main collection of pus, but at a part where the aponeurosis is thinnest, and, consequently, where the matter has the least resistance to overcome in getting to the surface of the body.

In all such cases the chief indication is to make an early and a depending opening with a lancet, so as to prevent the extension of the abscess, and to let the matter escape as fast as it is formed. If a spontaneous opening should have occurred in an unfavourable place, a new aperture must be made in a proper situation; or if the former should be sufficiently depending, and near the principal accumulation of matter, but too small, it must be rendered larger with a curved bistoury and a director. Whenever any black dead pieces of fascia present themselves at the opening, they must be taken hold of with a pair of forceps, and extracted.

It is well observed by Mr. Mayo, "that the principal part which aponeuroses and fasciæ play in disease is mechanical; they are tense, strong, and unyielding. But what is salutary support in the healthy condition of a limb, is liable to produce painful and mischievous tension and confinement in disease." (See *Mayo's Outlines of Human Pathology,* p. 127.) Hence one reason for dilating gunshot and punctured wounds, and for the rule of making a free division of fasciæ in operations. These textures may be the seat of phlegmonous, rheumatic, and venereal inflammation. The latter affection has been seen on the aponeuroses of the arm and leg, in connection with syphilitic periosteal inflammation and suppuration of the tibia. (*Mayo, Op.* cit. p. 128.)

APPARATUS. Every thing necessary in the performance of an operation, or in the application of dressings. The apparatus varies according to circumstances. Instruments, machines, bandages, tapes, compresses, pledgets, dossils of lint, tents, sponges, basins of water, towels, &c. &c. are parts of the apparatus, as well as any medicinal substances used.

It is a rule in surgery to have the apparatus ready before an operation is begun. All preparations of this kind should be made, if possible, out of the patient's room and presence, as they might agitate and render him timid.

We have been rightly censured by a French surgeon, for our too common neglect of what has been here recommended. "In France," observes M. Roux, "we are careful not to let a patient, who is to undergo a serious operation, see any of the requisite preparations for it. We hasten as much as possible the immediate preparatory measures, in order not to prolong unnecessarily the restlessness and moral agitation, which the expectation of an operation, and sometimes of the slightest one, always produces. These precautions are neglected by the English surgeons; at least by most of those whom I saw operate. They even neglect them in private practice, where, more commonly than in hospitals, we have to deal with pusillanimous individuals, who are easily alarmed, and whose extreme susceptibility it is of importance to spare. It was in the very room where the patient lay, of course under his eyes, that the table and all the necessary instruments for lithotomy, were arranged at an operation, which I saw done in London, during my stay in that capital, by a gentleman at the head of his profession." (See *Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise*, p. 105.)

M. Roux in his visit to London, had also too good reason to complain of the slovenly objectionable practice of leaving the application of the tourniquet, and the dressing of the wound after a surgical operation, to mere novices and students. I entirely coincide with him, that, in respect to the dressings, in particular, a surgeon is bound to extend his attention and solicitude a little beyond the moment when the operation terminates.

APPARATUS MINOR; APPARATUS MAJOR; APPARATUS ALTUS. Three ways of cutting for the stone. (See Lithotomy.)

AQUA PICIS LIQUIDÆ. *Dubl.* Take of tar two pints; water a gallon. Mix them with a wooden rod for a quarter of an hour, and after the tar has subsided, let the liquor be strained, and kept in well-corked bottles. This lotion is often used in porrigo, and ulcers surrounded with scorbutic redness. (See Liquor.)

ARCHOPTOSIS. See Anus, Prolapsus of.

ARGENTI NITRAS. (*Nitrate of Silver, lunar caustic.*) See Silver, Nitrate of.

ARSENIC was the chief ingredient in a secret remedy, which long obtained celebrity in Ireland for the cure of cancer, and is now well known amongst surgeons by the name of Plunket's caustic. This application consists of the ranunculus acris, the greater crowfoot, the flammula vulgaris, and the lesser crowfoot, in the proportion of an ounce of each, bruised and mixed with a drachm of the white oxide of arsenic, and five scruples of sulphur. The whole is to be beaten into a paste, formed into balls, and dried in the sun. When required for use, these balls are beaten up with yolk of egg, and spread upon a piece of pig's bladder. The use of the ranunculus is to destroy the cuticle, upon which the arsenic would have no effect; for it is to be observed, that Plunket's caustic was employed for the dispersion of tumours, as well as for the relief of ulcerated cancers. The application is to remain on the part twenty-four hours, at the end of which the slough is to be dressed with any simple unirritating ointment. When arsenic was first recommended as an application for cancers, it used generally to be blended with opium. When Plunket's caustic is employed, so as to form an eschar over a scirrhous tumour, I conjecture, that if it ever do good, it is not by any specific effect of this arsenical application, but simply by its producing a slough, or issue, near the disease. It is highly probable, also, that the swellings which have been thus dispersed, have never been complicated with the structure characteristic of true scirrhi. With respect to cancerous ulcers, Plunket's caustic sometimes produces a degree of amendment, which, however, rarely lasts for any considerable time; but many inveterate ulcerations, and anomalous sores, derive permanent benefit from it, and are even completely cured by it. Some examples of lupus, ulcerations about the roots of the nails, and reputed carcinomatous sores of the lips, are of this description.

At Paris, an arsenical paste was formerly used by Dubois, and other surgeons of that capital, for cancerous sores of the penis, and other malignant ulcers. It was composed of seventy parts of cinnebar, twenty-two of sanguis draconis, and eight of the white oxide of arsenic, formed into paste with saliva at the time when it is to be employed. "The pain and inflammation that succeed the use of it (says Mr. Crosse) cannot be equalled by the severest operations with the knife." (*Sketches of the Medical Schools of Paris*, p. 45. 8vo. 1815.) Even death may be occasioned by the absorption of the poison, as appears from the two annexed facts, the first of which is recorded by M. Roux, in his *Médecine Opératoire.* "The day after the paste was applied, the patient complained of colic and severe vomiting, and in two days perished in convulsions, *et les plus vives angoisses.* The body went quickly into putrefaction. The internal coat of the stomach, and a great part of the intestinal canal, were inflamed, and marked here and there with dark spots." Just before I visited Paris (adds Mr. Crosse), I dissected in London a woman, who died under similar circumstances, and where the same morbid appearances were presented, &c. (*Op.* cit.)

Justamond's applications to cancer were generally combinations of arsenic and sulphur. One formula was an ounce of yellow arsenic, with half that quantity of armenian bole, and sometimes as much red precipitate. He also employed a sulphuret of arsenic, and a combination of this sulphuret with crude antimony. The arsenical preparation selected for use was scraped, and laid on the middle of the sore, the edges of which were moistened with a combination of the muriate of iron and muriate of ammonia. In some instances, it is alleged, the effects of the treatment were the correction of the fetid smell, melioration of the appearance of the sore, and separation of the cancerous part.

In the Pharmacopœia Chirurgica, Justamond's arsenical caustic is directed to be made in the following manner:—℞. antimonii pulverizati, ℥ j. Arsenici pulverizati, ℥ij. These are to be melted together in a crucible. The application may be reduced to any degree of mildness by blending with this pulverized caustic a quantity of opium in the form of powder, which was also supposed to act specifically in diminishing pain.

The powder of white oxide of arsenic, unmixed with other substances, has sometimes been sprinkled upon cancerous and other inveterate ulcers; but the practice is now abandoned by every judicious surgeon, on account of the violent pain resulting from it, and the not unfrequently fatal consequences of its absorption. Could I suppose that a man, so rash and ignorant as to revive this murderous practice, yet existed in the profession, I should feel disposed to lengthen these remarks; but I am persuaded, that, in this country at least, more judgment and knowledge every where prevail. The white oxide of arsenic, however, may be applied with more prudence in other forms; either in one of those already specified; or as a lotion, composed of eight grains of the oxide, and the same quantity of subcarbonate of potash, dissolved in four ounces of distilled water; or as an ointment, formed by rubbing together one drachm of the oxide, and twelve drachms of spermaceti ointment. (See *A. T. Thomson's Dispensatory*, p. 51.)

Febure's celebrated remedy consisted of ten grains of the white oxide of arsenic, dissolved in a pint of distilled water, to which were then added an ounce of the extractum conii, three ounces of the liquor plumbi subacetatis, and a drachm of laudanum. With this fluid the cancer was washed every morning. Febure likewise gave arsenic internally; and his prescription was two grains of the white oxide; a pint of distilled water; syrup of chicory, q. s.; and half an ounce of rhubarb. Of this mixture, a table spoonful was given every night and morning, with half a drachm of the syrup of poppies. Each dose contained about one-twelfth of a grain of arsenic; but, in proportion as the patient was able to bear an increased quantity, the dose was gradually augmented to six table spoonfuls of the solution.

The arsenite of potash is an excellent preparation for internal exhibition. It is the active part of the liquor arsenicalis, L. P. The Dublin Pharmacopœia directs the arsenite of potash to be made as follows:—Take of white oxide of arsenic, nitrate of potassa, each an ounce. Reduce them separately to powder; then, having mixed them, put them into a glass retort, and place it in a sand-bath, exposed to a gradually raised heat, until the bottom of the retort becomes obscurely red. The vapours, arising from the retort, should be transmitted through distilled water by means of a proper apparatus, in order that the nitrous acid, extricated by the heat, may be disengaged. Dissolve the residue in four pounds of boiling distilled water; and after due evaporation set it apart, in order that crystals may form. This preparation has long been known under the name of Macquer's arsenical neutral salt. It may be given in the following way:—℞. Potassæ arseniatis gr. ij. Aq. menthæ viridis. ℥iv. Spir. vinosi tenuioris ℥j. M. et cola. Dosis drachmæ duæ ter quotidie.

The following was Dr. Fowler's method of preparing arsenic for internal use:—Take of the white oxide of arsenic, and pure subcarbonate of potash, each sixty-four grains. Boil them gently in a Florentine flask, or other glass vessel, with half a pound of distilled water, until the arsenic is dissolved. To this solution, when cold, add half an ounce of the compound spirit of lavender, and as much water as will make the whole equal to a pint, or fifteen ounces and a half in weight. The dose of this solution, of which the liquor arsenicalis L. P. is an imitation, is as follows:—From two years old to four M. ij or iij to v; from five to seven, M. v to vij; from eight to twelve, M. vij to x; from thirteen to eighteen, M. x to xii; from eighteen upwards, M. xii. These doses may be repeated every eight or twelve hours, the medicine being diluted with thick gruel, or barley-water. As the preparation is decomposed by the infusion and decoction of cinchona, it should never be ordered with either of these medicines.

Dupuytren was in the habit of employing certain preparations of arsenic, which cleaned the diseased surfaces without destroying them. One of his formulæ was a powder; the other a liquid. The arsenious acid constituted the basis of both. The calomel, joined with it, he conceived might have some effect; but the arsenic was the essential thing. The powder consisted of four parts of arsenious acid, or oxide of arsenic, and ninety-six of calomel. Sometimes the proportion of arsenic was increased to five or six parts in the 100. The liquid preparation was principally the above powder mixed with gum arabic, and moistened with distilled water, so as to make a paste. In the letter formula, however, Dupuytren usually increased the proportion of arsenic, employing six, eight, ten, or twelve parts of arsenic, with so many parts of calomel as made, with the arsenic, 100. Dupuytren employed this application with considerable success for the cure of many phagedenic ulcerations of the lips, and other parts of the face, approaching almost to cancer in respect to obstinacy. (See *Clinique Chir.* t. iv. p. 471.) In the North London Hospital, I employed Dupuytren's arsenical powder last year, in one or two instances of the same kind, with complete success. In lupus, or noli-me-tangere, it is a valuable application.

It will only be in my power to specify here a few of the numerous surgical cases in which the internal employmant of arsenic has been proposed. The following are particularly worthy of attention: tetanic affections; cancer; lupus; elephantiasis; inert cases of lepra (see *Bateman's Pract. Synopsis of Cutaneous Diseases*, p. 33. ed. 3.); various unnamed malignant ulcers; certain forms or sequelæ of the venereal disease, or other unintelligible diseases, which cannot be subdued by mercury; different cutaneous affections, &c. A longer list of diseases, for which a trial of arsenic is suggested, may be seen in some papers published by Mr. Hill. (*Edin. Med. and Surg. Journ.* vols. v. vi.)

Arsenic was recommended by Dr. J. Hunter for the prevention of hydrophobia. (See *Trans. of a Society for the Improvement of Medical and Chir. Knowledge*, vol. i.) Later trials of it, however, do not appear to entitle it to any confidence. Dr. Marcet found it quite unavailing, though not less than three drops of Fowler's solution were taken every other hour, in two drachms of peppermint, or sweetened water. (See *Med. Chir. Trans.* vol. i. p. 141. 156.) After the symptoms of hydrophobia have once begun, arsenic is decidedly useless.

But although it fails in hydrophobia, some facts published by Mr. Ireland, and certain observations and experiments, detailed in Dr. Russell's work on Indian serpents, make it appear a truly valuable remedy for the effects of the bites of serpents. (See *Med. Chir. Trans.* vol. ii. p. 393.)

In cases of poison by arsenious acid, or arsenite of potassa, practitioners universally agree respecting the first indication; which is, to empty the stomach as quickly as possible, with the stomach pump or an emetic. In this country, if the pump be not at hand, the common practice is to exhibit an emetic of sulphate of zinc, or sulphate of copper, which (it is said) ought to be preferred; first, because it does not require much dilution for its action — a circumstance of no small importance where poisons act by being absorbed; and, secondly, because it is extremely expeditious, a dose of fifteen or twenty grains producing almost instantaneous vomiting, without exciting that previous stage of nausea, which so frequently characterises other emetics, and which produces a state of the vascular system highly favourable to the function of absorption. (See *Pharmacologia by Dr. Paris*, p. 232, vol. i. ed. 5.) If the pump be used, Dr. A. T. Thomson is of opinion, that lime-water should be used to wash out the stomach. The union of lime and arsenious acid forms a nearly insoluble salt; so that while we are freeing the stomach from its deleterious contents, we are also lessening the virulence of any part of it which may remain. If the above emetics be given, lime-water should be drunk immediately after the first act of vomiting. Oil, and also milk, may be given; but no diluent fluid, calculated to dilute and dissolve the arsenious acid. Alkaline solutions are objectionable, because the alkaline arsenites are very soluble, and as poisonous as arsenic itself. (See *Thomson's Elements of Therapeutics and Materia Med.* p. 518. ed. 2.)

On the other hand, instead of the use of violent emetics, like antimon. tart. and sulphate of zinc, which, Orfila says, always increase the irritation created by the poison, he prefers exciting vomiting by making the patient drink large quantities of warm water, milk, water containing sugar or honey, linseed tea, and other mucilaginous fluids, the experiment of tickling the throat with a feather, or finger, not being omitted. After as much of the poison has been discharged by vomiting, as can be thus evacuated, the stomach may be mechanically washed out with the stomach pump; a plan, first proposed by Boerhaave, and afterwards improved by MM. Dupuytren and Renault. (See *Orfila, Toxicologie Générale*, t. i. p. 132. ed. 2. 1818. See also *Mr. Jukes's Obs. on this subject* in *Med. and Phys. Journ. for Nov.* 1822, *and June* 1823; also *Lancet*, vol. i.) By this means, the contents of the stomach may either be pumped out at once, or any fluid may be first injected, and then drawn out again. As arsenic produces its fatal effects chiefly by being absorbed, an important indication, according to this principle, is to administer only such liquids as are least liable to dissolve the arsenic in the stomach. On this account lime-water has been recommended as proper to be drunk after the stomach has been emptied by vomiting. It is remarked by Orfila, that lime-water with milk offers no particular advantage in cases of poison with the solid arsenical acid; but, where this acid is fluid, he admits the great utility of lime-water, as, in this circumstance, an insoluble arsenite of lime is formed, the action of which is very weak. This last observation is confirmed by experiments on dogs. (*Toxicologie Générale*, t. i. p. 233. ed. 2.)

When inflammation of the abdomen, and alarming nervous symptoms prevail, the means of relief are leeches, venesection, the warm bath, fomentations, emollient clysters, and antispasmodic narcotic medicines.

Success will depend, in a great measure, upon the regimen observed during the patient's convalescence: he should be chiefly nourished with milk-gruel, cream, rice, and beverages of a mucilaginous nature. (See *Orfila.* t. cit. p. 235.)

In 1834, the peroxide, or hydrated tritoxide, of iron was discovered, by Dr. Bunsen, to be a powerful antidote, if administered in time. (See *J. G. Crosse*, in *Prov. Med. Trans.* vol. v. p. 51.; *J. Robson*, in *Lond. Med. Gaz. Nov.* 5. 1836.)

ARTERIES. The process, by which a divided or punctured artery is healed, is particularly considered under the word Hemorrhage; while the general principles, which ought to be observed in the application of the means for the stoppage of bleeding, may be collected partly from the remarks contained in that part of the work, and partly from what is stated in the articles Amputation, Aneurism, and Ligature. As the condition of a bleeding patient admits of no delay, and the preservation of his life entirely depends upon proper measures being immediately taken, no man ought to be suffered to profess surgery, who is not competent to the treatment of wounded arteries, whether injured by accident, or in a surgical operation. Loss of limb, or life itself, is the too frequent consequence of such ignorance. Thus, Langenbeck recites the case of a turf-cutter, who let the instrument with which he worked fall against the lower part of his leg, whereby the posterior tibial artery was wounded. The blood gushed out profusely, and the surgeon who was sent for applied a tourniquet to the popliteal artery, and thus stopped the bleeding for a time; but, unfortunately, the tourniquet was kept so long on the limb, that the foot mortified, and sloughed away. (*Bibl. für die Chir.* b. i. p. 231, 232. Gott. 1806.) From the explanations, delivered in the article Hemorrhage, it will be seen, that, in all bleedings from considerable arteries, nothing is equal to the ligature, as a means of preventing the further loss of blood; and it may be laid down as a standing rule, that each extremity of the wounded vessel should be tied as near as possible to the wound in its coats. As Mr. Hodgson has remarked, "the necessity of tying both ends of a wounded artery is evident from the fact, that the anastomoses in all parts of the body are so extensive, as to furnish a supply of blood, which may pass through the lower extremity of the wounded vessel in a sufficient stream to produce an alarming, and, in some instances, a fatal hemorrhage." (*On Diseases of Arteries, &c.* p. 469.) This correct observation is followed by a case, in which the bleeding from the lower end of a divided brachial artery caused the patient's death. Of course, the inference is, that both extremities of the vessel ought to have been tied directly after the receipt of the wound. With regard to tying the trunk of an artery in a part of the limb, where it can be exposed with facility, when it is difficult to secure its bleeding extremities, as Mr. Hodgson remarks, the practice "was falsely deduced from a knowledge of the fact, that the ligature of an artery at a distance from the disease will effect the cure of an aneurism. But, a more intimate acquaintance with the condition of a limb after such an operation, and the processes by which the cure of an aneurism is effected after the modern operation, afford a complete illustration of the inefficacy and danger of this mode of treating a wounded artery; for it is now fully proved, that, when an artery is tied, a stream of blood continues to pass through it below the ligature." (P. 471.) This well-informed surgeon is aware, however, that instances do occur, in which only the upper end of a wounded artery is tied, and yet the patient recovers without hemorrhage from the lower orifice, which is closed by the natural processes.

In the year 1814, in Holland, I took up the femoral artery, in the middle of the thigh, in a case where the popliteal artery had given way, ten days after the passage of a musket-ball through the ham. I employed only one smallish ligature, which was applied with the precaution of not detaching the artery from its natural connections. The hemorrhage was effectually stopped, and the wound healed in the most favourable manner. Here, no doubt, the inflammation in the ham had obliterated the portion of the artery immediately below the point at which it had sloughed, or ulcerated; and there might even have been, from the same cause, some deposition of lymph within the upper portion of the popliteal artery, contributing to the success of the operation. But, no doubt, it was the diminution of the impulse of the circulation by the ligature of the femoral artery, which enabled nature to complete the obliteration of the wounded part of the vessel. In 1834, I cut down to and tied the popliteal artery in the North London Hospital, to stop hemorrhage from the posterior tibial artery, which had been wounded in a boy who, in cleaning a window, slipped, and thrust his leg through a pain of glass. As, in consequence of the house-surgeon having made several ineffectual attempts to stop the bleeding by ligature of the posterior tibial, there was an extensive ill-conditioned wound, I judged it better to tie the popliteal artery, than to increase the disturbed state of the parts lower down. The operation, which was attended with no difficulty, succeeded completely, as the ligature of the femoral artery has done in the hands of Dupuytren, Delpech, and others, for the stoppage of hemorrhage from the tibial arteries in compound fractures of the leg. Sometimes, says Mr. Hodgson, when hemorrhage takes place, a few days after the bleeding from a wounded artery has been stopped by compression, one extremity of the vessel will be pervious, whilst the other will have closed by the natural processes. Cases have even occurred, in which the upper end of the artery has been closed by the natural processes, whilst those processes failed in effecting the obliteration of the lower extremity of the vessel, from which a serious hemorrhage took place. *Hodgson, Op.* cit. 475.; and *Guthrie*, in *New Med. and Phys. Journ.* vol. iv. p. 177.) Indeed, in the example in which I took up the femoral artery myself, it was impossible to say positively, whether the blood came from the part of the popliteal artery above, or below the slough in it, as no incision was made into the ham.

It is observed by Mr. Guthrie, that the lower end of a divided artery is more prone to secondary hemorrhage than the upper; and that when bleeding returns, after having been arrested for a period of four hours, it takes place, in all probability, from the lower end. "This (says he) may always be known by the darker colour of the blood, and by its flowing out in a continuous stream, in the same manner as water rises from a spring, and not with any arterial impulse." (See *Guthrie, On Dis. and Inj. of Arteries*, p. 248.) His observations lead him to conclude, that the retraction and contraction of the lower end of a divided artery, is neither so perfect nor so permanent as at the upper end; and that the internal coagulum (see HEMORRHAGE) is in many instances altogether wanting, or very defective in its formation. (P. 251.)

In this work Mr. Guthrie censures the common fear about cutting muscular fibres, in operations to secure wounded arteries; and, in support of his own view, points out the inconveniences attending the plan of taking up the posterior tibial artery, as described by Mr. Harrison (see *Surgical Anat. of the Arteries*, p. 177. vol. ii. ed. 2.) Instead of this, he is an advocate for dividing muscles entirely, or the fibres of a muscle, by an extensive transverse incision, if likely to facilitate the application of the ligature to a wounded artery. (P. 261.) This last maxim, however, is not entirely new, Desault having long ago recommended cutting the sartorius across to get at the femoral artery; Scarpa, the pectoralis major, to get at the wounded axillary artery; and Dupuytren, the anterior scalenus, to reach a particular point of the subclavian. (See ANEURISM.) Mr. Guthrie disapproves of the directions given in some of the latest works for the ligature of the wounded posterior tibial and axillary arteries, and makes some remarks on "the manner of securing the ulnar artery, when wounded a little below its origin, and whilst covered by the pronator teres, and the superficial flexors of the fore-arm; viz. the flexor carpi radialis palmaris longus, and flexor digitorum sublimis. Here, instead of regarding the operation as impracticable, on account of the intervention of these muscles, or tying the brachial artery, he is an advocate for making a clean incision down to the artery, through all the muscular fibres interposed between it and the surface, avoiding the median nerve, which runs between the two origins of the pronator teres, and placing a ligature above and below the wound in the artery." (P. 271.) "It is necessary to be attentive to the course of the great vessels and nerves, but not to the safety of muscular fibres, the division of which leads to no permanent injury." (P. 319.) Mr. Guthrie also strongly protests against Dupuytren's practice of tying an artery injured by gun-shot, or a fractured bone above the place of injury, instead of exposing the vessel at the wounded point, and applying a ligature above and below the opening in it; a subject which I shall notice in subsequent articles. (See FRACTURE and GUN-SHOT WOUNDS.)

The principle, respecting the application of a ligature to each end of every large divided artery, is to be extended also to punctured arteries, one ligature being placed above, and the other below the opening in the vessel.

When an artery is merely cut or torn, but not completely divided, it seems to Mr. Guthrie to be in the same state, with regard to hemorrhage, as if it had given way by ulceration. It can neither retract, nor contract; and, unless pressure be accurately applied, and maintained, will continue to bleed, until the patient is destroyed. "The practice to be pursued (says he), is to divide the vessel, if it be a small one, such as the temporal artery, when it will be enabled to retract and contract, and the bleeding will soon cease. If an artery of larger dimensions be wounded, a ligature should be applied above and below the wound; and the vessel may, or may not, be divided between them, at the pleasure of the surgeon." (*On Dis. and Inj. of Arteries*, p. 253.)

From some observations in the article ANEURISM, it will be seen, that when the impulse of the circulation has been lessened by the ligature of the main trunk of an artery, some distance above the wound, the hemorrhage from the more remote portion of the vessel may sometimes be effectually restrained by pressure, which, previously to the stoppage of one great current of blood to the part, had proved unavailing. This fact is worth remembering in cases, in which the arteries of the hand or foot are wounded.

Mortification is observed to be more frequent after the ligature of an artery for a wound, than for an aneurism. In wounds Mr. Hodgson very correctly, I think, refers the difference to the frequent injury of the surrounding parts, and particularly of the veins and nerves, and to the loss of blood, and want of quietude, and proper care, after the accident. The principal anastomosing vessels are also sometimes divided. (P. 479.)

In the article Aneurism, I noticed the questions about the propriety and safety of tying both carotids, and whether this could be done without extraordinary risk, when no interval was left between the two operations. With respect to these points, I find that M. Manec is decidedly of opinion, that both the common carotid arteries may be tied at once in the same individual, without any marked or lasting derangement in the functions of different parts of the head. He believes that the numerous anastomoses, which exist in the interior of the skull, between the terminating branches of the vertebral arteries and those of the internal carotid, are more than sufficient for the ready conveyance of blood from the former into the latter, and for the prevention of the brain from being sensibly affected by the obliteration of the two common carotids. Externally, the numerous communications between the branches of the external carotids, and those of the two subclavian arteries, more particularly the free anastomosis of the lower thyroid with the superior thyroid arteries, and those of the ascending cervical with the occipital arteries, leave no doubt in M. Manec's mind respecting the correctness of the opinion which he has advanced. He has frequently tied both the common carotids in animals, without the slightest impairment of their intelligence, or of their general health. At the period when he was recording his views of this subject, there was in the dissecting-room of the hospital a large strong healthy dog, on which he had performed this operation four years previously; and whose intelligence continued perfectly undiminished. So fully convinced is M. Manec of the safety with which it may also be practised on the human subject, that he wished to undertake it on a young man who had an extensive tumour of erectile tissue on the face, but who would not submit to the proposal. (See *Manec, Traité, &c. de la Lig. des Artères*, pl. iv.)

Having explained in the article Aneurism the plans adopted by some of the most celebrated operators, in cutting down to and tying many of the principal arteries, I will now introduce some additional instruction on this very important subject.

Perhaps, in no operation of tying an artery, is the exclusion of the vein and nerves of so much consequence, as it is in that of applying a *ligature to the common carotid artery*. As Dupuytren remarks, this fact depends upon the importance of the organs to which the adjacent nerves are distributed, viz. the heart, lungs, and stomach. (See *Leçons Orales, &c.* t. iv. p. 17.)

The right common carotid trunk is much shorter than the left; the former arising from the brachiocephalic trunk, the latter from the arch of the aorta. Both terminate opposite the space between the os-hyoides and upper edge of the thyroid cartilage; and behind each of them are the longus colli and rectus capitis anticus muscles, placed in front of the cervical vertebræ. In the lower part of the neck, the trachea is near their inner side; higher up, the thyroid gland; and still higher up, the larynx and pharynx. The external side of the common carotid is in contact with the internal jugular vein, which partly overlaps it; while, between the two vessels, but rather behind them, and enclosed in the same common sheath with them, the pneumogastric nerve descends. In the lower part of the neck, the carotid sheath has behind it the recurrent laryngeal nerve and the inferior thyroid artery. The descending branch of the ninth nerve commonly lies upon the forepart of the sheath, closely connected to it, and about the middle of the neck, forms a plexus, with some filaments from the second and third cervical nerves. At the upper part of the neck, it lies rather towards the outer side of the sheath; at the lower, on the inner side of it. Mr. Harrison has often found it within the sheath, behind the jugular vein. The sympathetic and cardiac nerves are situated between the sheath and the rectus anticus major muscle. The common carotid artery is covered below by the skin, platysma, and cervical fascia, and also by the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles. Opposite the upper rings of the trachea, it is crossed by the omohyoideus. But, from this point to its bifurcation, the vessel is covered only by the skin, platysma, and fascia. The omohyoideus, as it proceeds from the shoulder behind the sterno-mastoid muscle, divides the artery into an upper and lower portion, and the side of the neck into two triangular spaces. In the lower triangle, bounded by the trachea, clavicle, and omohyoideus itself, the common carotid is concealed by the sternal origin of the mastoid muscle, and lies deeply. But, in the upper triangle, bounded externally by the margin of the sterno-mastoid muscle, above by a transverse line, denoting the uppermost extent of this space below the os hyoides, and below by the omohyoideus, the vessel is much more superficial. Here, however, a plexus of veins often lies directly in front of the carotid sheath. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 234.; *Quain's Anatomy*, ed. 2. p. 437.; *Harrison's Anat. of Arteries*, vol. i. p. 19. ed. 2.; *Manec, Traité de la Lig. des Artères*, No. i. pl. iv.) A chain of absorbent glands lie near the carotid sheath, principally on its external side, and are partly concealed by the sterno-mastoid muscle, and covered by the cervical fascia. In young subjects, they are large and numerous; "they are frequently enlarged and indurated by chronic inflammation; the muscles and fascia press them closely to the vessels; they become fixed, and have a pulsation communicated to them, so as to resemble aneurism." (*Harrison, Op.* vol. cit. p. 21.)

The operation of tying the common carotid is sometimes performed while the patient is in the sitting posture; but, on account of the chance of his becoming faint, I consider the recumbent position best, with the chest somewhat raised, the neck moderately extended, and the chin turned towards the opposite side. If the artery is to be tied below the omohyoideus, the front edge of the sterno-mastoid muscle is to be first felt for, and an incision, three inches long, made in the direction of it, commencing opposite the cricoid cartilage, and directed towards the sterno-clavicular articulation, a little above which it is to terminate. On the other hand, when the artery is to be taken up above the omohyoideus, the incision through the skin should begin higher up, and not be continued so low down. The second stroke of the knife divides the platysma myoides and cervical fascia, so as to bring into view the fibres of the sterno-mastoid muscle. Unless this last incision be made over the latter muscle, it is best to pinch up a portion of the cervical fascia with the forceps, and cut it across, so as to make a small opening in it for the introduction of a director, on which it is to be slit up. (See *Quain's Anatomy*, p. 450. ed. 2.) An assistant now draws the inner margin of the wound, and the sterno-thyroid and sterno-hyoid muscles, towards the median line, while the surgeon himself draws the external margin of the wound, and the sterno-mastoid muscle, outward. For this purpose, blunt hooks are sometimes preferred, as not concealing the parts so much as the fingers.

The *omohyoideus* is now seen running across the wound in the form of a red cord, and above and below it are the vein and artery, enclosed in their common sheath.

This sheath should be opened over the artery, and not over the vein, with the aid of a pair of forceps and a director. If the jugular vein swell up so much as to conceal the parts, pressure is to be made on it at the upper angle of the wound. (See *Velpeau, Nouv. Elém. &c.* t. i. p. 241.) Then an eye-probe, or aneurism-needle, is to be conveyed between the vein and artery, and under the posterior surface of the latter, without meddling with the pneumogastric nerve, the great sympathetic, or any of their branches.

It seems to M. Velpeau, that if the surgeon were to cut at first to the inner side of the mastoid muscle, there would be some risk of mistaking the sterno-hyoideus for it, and getting wrong. He thinks it better, therefore, to cut down upon the surface of the sterno-mastoid muscle, a few lines from its anterior margin. As the coats of the vein are very thin and easily torn, the knife is never to be applied near it.

If the sheath were not duly opened, the pneumogastric nerve, situated within its posterior layers, between the carotid and jugular vein, would certainly be tied, and the cardiac nerves and descendens noni be in danger of suffering the same fate.

The ligature of the common carotid above the omohyoideus is rendered easier by the more superficial situation of the vessel, which is merely covered by the skin, platysma, and the cervical fascia. The incision is to commence a little below the angle of the jaw, and be continued down to the extent of about three inches in the upper triangle of the neck, that is, in the interspace between the sterno-mastoid muscle and the larynx. The skin and platysma having been divided, the cervical fascia is to be pinched up with a pair of forceps, and an opening made in it by cutting it across. Then a director is to be introduced, and the operation finished according to the directions already given, as applicable to that below the omohyoideus.

In the operation of applying a *ligature to the subclavian artery, on the outside of the scalenus anticus*, the patient is to lie on his back, with his shoulders somewhat raised. The head and neck are to be turned towards the sound side, while an assistant depresses the shoulder, and raises the arm from the side. The first incision is to be made transversely, an inch above the clavicle, as Velpeau prefers, or near, or even upon, as many other surgeons prefer, from the outer edge of the sterno-mastoid muscle to the front edge of the trapezius. After the integuments have been cut, the platysma myoides is to be divided. The external jugular vein itself may generally be drawn aside with a blunt hook; but, if this cannot be readily done, a double ligature must be put under the vein, and tied, after which it is to be cut through in the interspace. Then the cervical fascia is soon exposed, which is to be cautiously opened, by pinching a piece of it up with the forceps, and making a small opening, which is to be enlarged with the aid of a director. The edge of the scalenus anticus can then be immediately felt under and within the sterno-mastoid muscle. After having lacerated or separated the cellular tissue, absorbent glands, &c., in the bottom of the wound with a probe, or a director, the finger is conveyed towards the insertion of the scalenus, where the tubercle of the first rib will be felt; a little behind and on the outside of which the artery is always situated.

When once the artery is found, it is not necessary to bring it into view; for the nail being applied to its posterior and external side, serves as a guide for the bent eye-probe or aneurism-needle, the point of which is to be passed from before backwards, and a little from without inwards, the surgeon keeping his finger over the artery, between it and the lowermost nerve of the brachial plexus, so as to steady the vessel. (See *Velpeau, Nouv. Elém. &c.* t. i. p. 229.)

With reference to the *ligature of the external iliac artery*, I have but little to add to the account given of this subject in the article Aneurism. From the sacro-iliac symphysis, where the common iliac artery bifurcates, down to the crural arch, the external iliac artery describes a gentle curve, which is more marked in the female than the male subject, and the convexity of which is turned outwards and backwards. The artery descends along the inner margin of the psoas muscle, to which it is connected by a thin membrane, derived from the iliac fascia, situated behind the artery. Although the production from the iliac fascia is so thin that the artery and vein can be seen through it, yet it is sufficiently strong to prevent them from being displaced or separated. (See *Harrison's Surgical Anat. of the Arteries*, vol. ii. p. 117.) The vein lies to the inner side of the artery, and at first rather behind it; but, near Poupart's ligament, it is on the same plane as the artery, resting upon the os pubis, and upon a few fibres of the psoas and pectinæus muscles. The anterior crural nerve is on the iliac side of the artery, but on a plane posterior to it, and separated from it by the psoas, between which and the iliacus internus the nerve covered by the iliac fascia is imbedded. "Two or three small branches from this nerve, and from the lumbar plexus, are connected to the artery, and descend along its external side. These branches are distributed to the spermatic cord and to the integuments of the groin." (See *Harrison, Op.* cit.) The ureter, in its descent behind the peritoneum, crosses over the anterior surface of the external iliac artery, and so does the vas deferens. As for the peritoneum, it is connected to the external iliac artery merely by loose cellular tissue, and below quits the vessel entirely to be reflected over the posterior surface of the parietes of the abdomen. The only branches of importance, which the external iliac artery gives off, are the circumflexa ilii and the epigastric, which usually arise opposite the ilio-pectineal line, though sometimes a quarter or half an inch above, or below this point. The absorbent glands, which lie in the course of the external iliac artery, being sometimes enlarged, excite a suspicion of diseases which do not exist. On the right side, the cœcum, and, on the left, the sigmoid flexure of the colon, are the only viscera, interposed between the external iliac artery and the parietes of the abdomen. As MM. Bogros and Velpeau have noticed, nothing is easier, in a thin person, whose abdominal muscles are relaxed, than to make effectual pressure on this artery. M. Velpeau had an opportunity of ascertaining the truth of this observation in a young man, who met with an accidental wound of the artery above the origin of the epigastric, requiring the injured vessel to be tied without delay. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 172.)

In Abernethy's method of tying the external iliac artery, an incision is made, about three inches and a half in length, in the direction of the artery, down to Poupart's ligament. The aponeurosis of the external oblique muscle being thus exposed, is to have an opening cautiously made in it; and, a director being now introduced, the aperture is enlarged in the direction, and to the same extent, as the wound in the integuments. "The internal oblique and transverse muscles, which are closely connected with each other, are to be carefully cut into the lower part, so as to allow a director, or the point of a finger, to be introduced below them, when they also are to be divided, the finger separating them from the fascia tranvsersalis and peritoneum. The fascia transversalis, running from Poupart's ligament, to the peritoneum, is now to be torn through with the nail, immediately over the pulsating artery, and the peritoneum is to be separated by the finger, and pushed upwards until sufficient room is obtained; which, in this, as well as in all other operations on the iliac arteries, is sometimes difficult, on account of the protrusion of the intestines, covered by the peritoneum, when the patient is not sufficiently tranquil. The artery is yet at some depth, and covered by a dense cellular membrane, connecting it to the vein on its inside, and which must be torn through with the nail. The aneurism-needle should be passed between the vein and the artery, and the point made to appear on the outside of the artery." (See *Guthrie, On Dis. &c. of Arteries*, p. 373.) This description, with the observations in the article Aneurism, will suffice to render Abernethy's plan very intelligible.

To the account of Sir Astley Cooper's method of taking up the external iliac artery, given in that part of the Dictionary, I have nothing to add.

In the article Aneurism, a description is given of the operation of *tying the femoral artery* in the upper third of its course. If it were indispensable to apply a ligature to it in the *groin*, or *just below the crural arch*, the surgeon should remember, that here the situation of the artery corresponds to the mid point between the anterior superior spinous process of the ilium and the tuberosity of the os pubis; though, in women, in whom the pelvis is wider, the artery is rather nearer the pubes. The vessel may also be readily felt as it is passing over the os pubis, being only covered by the integuments, superficial fascia, some lymphatic glands, and the fascia lata. Immediately below Poupart's ligament, the femoral vein lies on the pubic side of the artery. The anterior crural nerve lies about half an inch away from the iliac side of the artery, imbedded between the iliac and psoas muscles. (See *Harrison's Surg. Anat. of Art.* vol. ii. p. 136.) Here the sartorius is completely to the outer side of the artery, not interfering in any way with its exposure, nor serving as a direct guide to it, as it does in the middle third of the thigh. In the operation, the limb should be extended and rotated outwards; an incision made, beginning about an inch above Poupart's ligament, and extended downwards in the direction of the artery, to the distance of two inches below this ligament. The layers of the superficial fascia are then to be divided to the same extent; and any lymphatic gland in the way pushed to one side, or, if enlarged and diseased, removed. The fascia lata is next to be divided, and the sheath of the femoral vessels pinched up with a pair of forceps, and cautiously opened. Lastly, the aneurism-needle, or eye-probe, used for the conveyance of the ligature under the artery, is to be introduced on the pubic side of this vessel, between it and the vein, so as to leave the latter completely safe. As in some individuals the origin of the profunda is unusually high up, and of nearly the same size as the femoral, one of them might be mistaken for the other. The profunda, however, is the more external of the two. The effect of pressure on each, in checking the hemorrhage, or the pulsation of an aneurism, will also be a guide to the operator. (See *Harrison, Op.* vol. cit. p. 160.) Sometimes a double femoral artery has been met with.

The direction, given by M. Malgaigne, to place the ligature as closely as possible above the origin of the profunda (*Man. de Méd. Opér.* p. 188.), if adopted, would be very likely to be followed by secondary hemorrhage, for reasons elsewhere explained. (See Hemorrhage.)

The operation of *tying the femoral artery in the middle third of the thigh*, not having been fully described in the article Aneurism, I annex the following particulars:—This artery, in its course from the crural arch to the lower third of the thigh, runs in the direction of a line, which, drawn from the centre of Poupart's ligament, descends obliquely inwards round the limb to the middle of the popliteal space. This description is nearly correct; but, as Dr. Quain observes, as this line runs along the inner surface of the thigh, its course is more oblique than that of the vessel, which is placed much nearer the shaft of the femur. (*Elem. of Anat.* p. 505. ed. 2.) In the middle third of the thigh, the femoral artery is more deeply placed than in the upper, because, in addition to the integuments, superficial fascia, and fascia lata, it has the sartorious lying over it, beneath which there is also another fascia extended over it, from the adductor muscle to the vastus internus. This fascia, though thin above, becomes very dense where the artery approaches the opening in the adductor magnus. In the groin, the femoral vein lies close to the inner side of the artery, but, as it descends, it gets more under the latter vessel, and, in the popliteal space, it is situated quite to the outer side of it.

An incision, three inches in length, is to be made along the inner edge of the sartorius, which is the common rule, and perhaps better than Lisfranc's modification, which consists in making an incision of this length in the mid space between the gracilis and sartorius; for, by exposing the fibres of the latter muscle, their very course affords useful instruction to the surgeon; for he then knows immediately where he is, and what ought to be done. The integuments and superficial fascia having been divided, and the fascia lata to the same extent, the inner edge of the sartorius is expose. This is to be gently raised, and drawn outwards. The fascia, extending from the vastus internus to the adductor, and covering the artery, is brought into view, and with the aid of a pair of forceps, and a director, it is to be cautiously opened, by which means the sheath of the femoral vessels will be exposed. Here the great saphænal nerve lies within the sheath, on the anterior and external side of the artery, and the rule is not to include it in the ligature. Lastly, the aneurism-needle is to be conveyed under the artery, between it and the vein. In making the incision through the integuments, the great saphænal vein should be avoided, by not directing the knife too obliquely downwards and backwards.

In addition to what has been stated in the article Aneurism, respecting the *ligature of the brachial artery*, I may observe, that the course of this vessel corresponds to an oblique line, drawn from the armpit to the middle of the bend of the elbow. The median nerve, which above runs along its radial margin, soon gets in front of it, and, crossing it very obliquely, passes quite to its ulnar side below. Two satellite veins usually accompany the artery, and even sometimes cover it, and thus separate it from the median nerve. The ulnar and internal cutaneous nerves, which lie near it above, separate further and further from it as they descend, in order to reach the inner part of the forearm. The artery, lying at first near the humerus, between the coraco-brachialis and the tendon of the latissimus dorsi, afterwards passes over the insertion of the coraco-brachialis, and gets upon the brachialis anticus, a little behind the inner margin of the biceps, which last muscles it accompanies to its termination. In the supine state of the hand, the brachial artery is less covered by the biceps; and hence, in the operation of taking it up, this position is advantageous. (See *Manec. Man. de Méd. Opér.* p. 166.) In thin subjects, the fascia is almost contiguous to it, and sends off a duplicature to include the artery, its two accompanying veins, and the median nerve, all which form, as it were, one common fasciculus.

The whole is covered by the common integuments, and, in the lower third of the arm, by the trunk of the basilic vein. The anomalies of the brachial artery are very frequent. Velpeau, and most other surgeons, have seen it divide near the axilla, and at nearly every other point between this and the elbow. In one subject, Velpeau found its bifurcation take place two inches above the trochlea of the humerus, to form the ulnar and posterior interosseous. In another, the latter was completely independent of both the ulnar and the radial. Sometimes the two trunks, produced by the bifurcation, pass down to the fore-arm parallel to one another; in other instances, they cross once, or several times; and it is not uncommon to find one piercing the fascia, so as to get immediately under the skin, while the other, which then gives off the radial and the interosseous, retains its ordinary relations. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 210.)

In the operation of *placing a ligature on the brachial artery at the bend of the elbow*, the surgeon should remember, that the course of the vessel here corresponds to a line drawn obliquely inwards and upwards, from the middle of the front of the elbow, to the inner border of the biceps. Its course is also denoted by the median basilic vein, which passes under the skin, almost in the same line as the artery. An incision, between two and three inches in length, is to be made through the skin, on the inner side of this vein, which is to be carefully drawn out of the way. Then, with the aid of a director, the fascia, and the fibrous production given off from the tendon of the biceps, are to be divided; which having been accomplished, the artery will present itself, bounded on the right and left by its two venæ sodales, the median nerve lying three or four lines from its inner border. To facilitate the passage of the aneurism-needle or director under the artery, the elbow is to be a little bent, and the instrument passed from within outwards under the vessel. (See *Manec, Op.* cit. p. 166.) If the operation were performed somewhat higher, the surgeon must remember, that two or three inches above the trochlea of the humerus, the median nerve would begin to be in front of the artery.

In the *upper part of the arm*, the brachial artery lies at the inner border of the coraco-brachialis, and has the median nerve at first external to it, and then in front of it. Below the insertion of the coraco-brachialis, it is situated at the inner edge of the biceps. Four circumstances are enumerated as guides for the external incision:—1. The inner edge of the coraco-brachialis above, and that of the biceps below. 2. A line drawn from the middle of the axilla to the middle of the bend of the elbow. 3. Placing the fingers on the median nerve, and cutting on its inner side. (*Lisfranc.*) 4. The pulsations of the artery. The knife is carried in the direction of the artery from above downwards in the right arm, and from below upwards in the left, and an incision made in the integuments, about three inches long.

With the forefinger the surgeon next endeavours to feel the median nerve, which presents itself as a round very hard cord; and to distinguish the artery by its pulsations. He then divides, with the aid of a director, one after the other, the fascia, and the sheath given off by it to the median nerve; and breaking, with the end of a probe or director, the fibro-cellular covering of the vessels, separates the artery from the veins, and puts a ligature under it. Except when anomalies occur, the operation is simple. M. Velpeau has only once seen the median nerve under the artery. In all ordinary cases, it is the first cord met with behind the inner margin of the biceps. (See *Velpeau, Nouv. Elém. &c.* t. i. p. 211.)

As some very celebrated surgeons have made the serious mistake of tying the median nerve for the brachial artery, I advise the practitioner never to tighten the ligature, until he has tried the effect of pressure on what he supposes to be the artery.

In order not to mistake the ulnar for the median nerve, and to be led to seek for the artery where it will not be found, it is an excellent rule to proceed in the operation from the anterior to the posterior part of the arm. (See *Manec. Man. de Méd. Opér.* p. 167.)

Ligature of the Radial Artery behind the Carpus.—If the thumb be forcibly extended, the tendons of its great abductor and long extensor will be made very prominent behind. In the depression between them, the pulsations of the radial artery can be felt. The thumb being drawn away from the forefinger, an incision, an inch and a half in length, is to be made in the direction of the foregoing tendons, first through the skin, and then through the fascia. The artery is then to be separated from some veins and nervous filaments, with a probe or director. (See *Manec. Op.* cit. p. 163.)

After the radial artery leaves the fore part of the wrist, it may be taken up by making an incision "on the outside of the insertion of the extensor primi internodii pollicis, and the inside of the extensor tertii internodii pollicis. Betwixt these tendons, the artery lies very deep, and over it is the extreme branch of the muscular spiral nerve. We find the artery going close to the notch, betwixt the os scaphoides and trapezium." (*Sir C. Bell, Op. Surgery,* vol. ii. p. 373.)

Ligature of the Radial Artery in the Lower Third of the Forearm. — Here the artery can readily be felt, being only covered by the fascia and the skin. On each side of it is a vein; but the radial nerve is considerably to the outer side of it, having passed under the supinator radii longus, a little below the middle of the forearm. An incision, two inches and a half long, is to be made a little way from the radial margin of the flexor carpi radialis, between this and the supinator longus. The fascia is to be opened, and the ligature passed from within outwards, or from without inwards, as the surgeon may choose, as it is a matter of indifference, the nerve being out of danger.

Ligature of the Radial Artery in the Upper Third of the Forearm. — Here the artery runs in the space which separates the supinator radii longus from the pronator teres and palmaris longus, covered by the internal border of the first of these muscles, and of course by the fascia and the skin. Is is always accompanied by two veins, and has the radial nerve at its outer side. Its course is accurately indicated by a line, drawn from the middle of the bend of the elbow to the mid point between the styloid process of the radius and the tendon of the palmaris longus.

In the direction of this line, M. Roux makes an incision, about two inches and a half in length, commencing a little below the elbow. If the median vein is met with, it is pushed aside. The fascia is then slit up with a director, and the border of the long supinator drawn outwards, without dividing it. The artery having been brought into view, the aneurism-needle, or eye-probe, is passed under it from without inwards, on account of the nerve. (See *Manec. Man. de Méd. Opér.* p. 164.)

Others adopt the following plan:—A finger is to be put on the insertion of the tendon of the biceps. A little below this insertion, an incision, about two inches and a half in length, is to be made in the integuments, in the oblique direction, denoted by the inner edge of the supinator radii longus. The subjacent fascia is then to be divided, and the inner edge of the supinator muscle drawn a little from the outer side of the arm: in the space between that muscle and the flexor carpi radialis, the radial artery immediately presents itself, passing over the tendon of the pronator radii teres, and the flexor longus pollicis. Afterwards it runs down between the latter-named tendon and the flexor carpi radialis. (See *Camper's Demons. Anat. Pathol.* lib. i. tab. 1. fig. 2.)

Ligature of the Ulnar Artery at the Wrist. — Here the artery passes on the radial side of the pisiform bone, with the ulnar nerve on its outer side, and a vein on each side of it. In this place an incision, two inches long, is to be made through the skin, cellular tissue, and palmar fascia, one after the other. The artery having been thus exposed, an eye-probe is to be passed under it from without inwards.

Below the middle of the ferearm, the ulnar artery is superficial, and may easily be taken up by making an incision upon the radial side of the flexor carpi ulnaris, between the tendon of which muscle and that of the flexor profundus digitorum, the vessel is situated. The artery, however, will not be reached until a thin aponeurosis under the fascia of the forearm has been divided. The nerve is rather more under the tendon of the flexor carpi ulnaris, than the artery. When the ulnar artery arises from the brachial above the elbow, it pierces and runs above the fascia, and is easily taken up in any part of its course.

For bringing into view *the ulnar artery at the upper third of the forearm,* the situation and breadth of the flexor carpi ulnaris muscle must first be ascertained. An incision is then to be made from above downwards, beginning two inches below the inner condyle of the humerus, and following the course of the inner margin of the above muscle to the extent of two inches and a half. The fascia is then to be divided; and the flexor carpi ulnaris drawn a little away from the flexor sublimis. In this opening, rather under the margin of the latter muscle, the ulnar artery will be felt with the finger, continuing its course over the flexor profundus. The ulnar nerve is situated on the ulnar side of the artery. Mr. Guthrie's opinions, respecting the propriety of dividing the muscles which conceal the upper third of the ulnar artery, have been noticed in the beginning of the present article.

Ligature of the Anterior Tibial Artery on the Foot.—The anterior tibial artery becomes superficial about six inches above the ankle, from which point it descends betwen the tendon of the tibialis anticus and that of the extensor of the toes. It passes with these tendons under the annular ligament, and rather nearer to the internal malleolus than the external; thence inclining inwards, it penetrates between the first and second metatarsal bones to the sole of the foot, where it inosculates with the external plantar artery. The inner branch of the deep dorsal nerve of the foot is at its inner side; its corresponding vein at its outer side. It is covered, — 1st, By a thin fibro-cellular expansion, separating it from the adjoining tendons. 2dly, By adipose cellular tissue. 3dly, By the fascia of the instep. 4thly, By the common integuments. On the instep, the first tendon of the extensor communis digitorum pedis, lies upon the outer side of the artery; that of the extensor of the great toe upon its inner side.

An incision, two inches and a half long, is made in the skin, in the direction of an oblique line from the middle of the instep, to the first interosseous space. The skin, adipose substance, and fascia, are to be divided; the fibro-cellular aponeurosis, between the tendons of the first two toes, opened; and the artery tied, after being separated, by means of a director, from the accompanying nerve and veins. (*Velpeau.*)

Ligature of the Anterior Tibial Artery in the Leg. — The two upper thirds of this artery lie close to the interosseous ligament; but lower down the artery advances towards the outer side of the spine of the tibia; consequently, the higher it is, the more deeply it is situated. The two veins accompanying it, inosculate across it by several small branches. The anterior tibial nerve crosses over it obliquely inwards and downwards, though sometimes it continues on its outer side down to the instep. The artery, veins, and nerve, are included in cellular tissue, which does not, however, form a true sheath for them. Above, the artery lies between the tibialis anticus and the extensor communis; in the middle of the leg, between the tibialis anticus and the extensor of the great toe; and still lower down, between the extensor of the great toe and the extensor communis.

In order to lay bare the anterior tibial artery, a little above the middle of the leg, the finger is to be passed along the outer side of the spine of the tibia, and the breadth of the tibialis anticus muscle is to be ascertained. Along the outer margin of this muscle, an incision is to be made through the integuments and fascia, two inches and a half in length. The knife is then to be introduced between the outer margin of the tibialis anticus muscle and the extensor longus of the great toe. In this space, at the depth of about an inch, the anterior tibial artery is situated. (See *Haller's Icon. Anat.* fasc. v. tab. 4.; also *J. P. Manec, De la Lig. des Artères*, pl. 12.)

Ligature of the Anterior Tibial Artery in its Lower Third. — The skin, the subcutaneous fat, the cellular tissue, and the fascia, are to be divided in succession, to the extent of about three inches, and in the direction of a line drawn from the mid point between the head of the fibula and spine of the tibia to the instep. Then, with a director or the fore-finger, the tendon of the extensor muscle of the great toe is to be separated from that of the tibialis anticus, pushing it outwards from the extensor communis, if the operation be at the upper part of the lower third of the leg; but inwards, if the operation be done quite at the inferior extremity of the leg. Nothing, then, remains to be done, but to separate the artery from its accompanying veins, and from the anterior tibial nerve, which in this part of the limb is at its inner side, having crossed it from the outer in its descent. (See *Manec*, pl. xii. fig. 1.; *Velpeau, Nouv. Elém. &c.* t. i.)

Ligature of the Anterior Tibial Artery in its Middle or Two Upper Thirds. — Lisfranc makes an incision extending obliquely from below upwards, from the spine of the tibia towards the fibula. Having cut transversely through the fascia, the interspace between the tibialis anticus and the extensors is sought for.

In the ordinary method an incision is made in the track of the artery, as determined by the line above specified, about an inch on the outside of the spine of the tibia. The skin and fascia are divided to the extent of three inches. The muscular interspace, at the bottom of which the artery will be found close to the interosseous ligament, is denoted by a yellowish line. In order to convey the ligature round the artery, Velpeau passes a director under it very obliquely, from below upwards, and from the fibula towards the tibia.

Ligature of the Posterior Tibial Artery. — From its origin, a little below the poplitæus muscle, to its division into the external and internal plantar arteries, the posterior tibial artery follows very precisely the direction of a line, with a slight convexity inwards, from the middle of the upper part of the calf to a point half an inch behind the internal malleolus. Two veins usually accompany it, sometimes forming by their anastomoses a complete network round it. In the upper part of the leg, the posterior tibial nerve lies to the inner or tibial side of the artery, but soon passes over it to the outer or fibular side. In the two upper thirds of the leg, the posterior tibial artery is deep seated, lying in the upper third upon the tibialis posticus, in the middle third upon the flexor digitorum communis; while lower down it is separated from the tibia only by fat and cellular tissue. From the gastrocnemius and solæus, it is divided by the deep crural fascia, which muscles lie over its two upper thirds. In the lower third, no muscles cover it.

In the arch of the os calcis, the posterior tibial artery is in contact with the fibrous sheath of the flexor communis digitorum, about half an inch from the posterior border of the inner malleolus. Here the nerve is behind it, the veins at the inner side. The artery is enveloped in cellular and adipose tissue. The internal ligament of the tarsus, a fibrous layer continuous with the fascia of the leg, after covering the artery, becomes blended with the dense cellular tissue interposed between the vessel and the skin. (*Velpeau.*) Between the internal malleolus and the lower part of the calf, the posterior tibial artery is somewhat further from the internal edge of the tibia, and the nerve is rather on its outer side than behind it. The deep-seated fascia, which is here very thin, keeps the artery bound down upon the tibialis posticus, flexor longus communis digitorum, and flexor longus proprius pollicis. External to this fascia, is the tissue that fills the sheath of the tendon of Achilles, and then the common fascia of the leg directly under the skin.

In the calf, the posterior tibial artery is very deeply seated, almost on the same plane as the posterior surface of the tibia, and much nearer to its external or fibular edge than its internal. It is covered by a strong fascia, that lies over the flexor muscles; and then by the tibial portion of the solæus; the internal head of the gastrocnemius; the fascia of the leg; the subcutaneous cellular tissue, in which are found the great saphenal vein and the internal saphenal nerve; and lastly, the skin. (See *Velpeau.*)

Ligature of the Posterior Tibial Artery. — The leg is to be bent and laid upon its outside.

Behind the malleolus internus. — An incision, slightly curved, with its concavity forwards, is to commence an inch above, and to terminate an inch below the posterior edge of the malleolus internus, and to be at least three lines behind it. It will, therefore, be between the malleolus internus and the tendon of Achilles. If the operation is to be performed in the hollow of the os calcis, it is necessary, as M. Velpeau directs, to divide the tissues cautiously, layer by layer, and to introduce a director under the fascia, previously to its division, lest the artery, which is sometimes very superficial, be wounded. If the incision were made too near the malleolus, the fibro-synovial sheath of the groove, which that process contributes to form, would be opened: if too far backward, the artery would be more difficult to find. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i.) In fact, behind the lower end of the tibia, the tendons of the tibialis posticus, and of the flexor commun-digitorum, pass in a kind of furrow. Along with these two tendons, but somewhat nearer to the os calcis, the posterior tibial artery descends to the sole of the foot.

The depth of the posterior tibial artery in the two upper thirds of the leg, makes it difficult to take it up in these situations. When necessary, however, it may be exposod, and tied above and below the wound in it, by proceeding as follows:— An incision, four inches in length, is made along the inner side of the tibia; the solæus muscle detached from the bone to the same extent, and reflected. The internal saphænal vein is to be avoided. Under the solæus muscle is found the fascia, which separates the muscles of the calf into superficial and deep-seated. When this fascia has been divided, the posterior tibial artery may be seen, or felt, deeply situated, running on the tibialis posticus and flexor muscle of the toes. (See *Haller*, *Icon. Anat.* fasc. v. tab. 5.; *Manec*, *De la Lig. des Artères*, fol. Paris, 1822, pl. 13.)

The method of trying to take up the posterior tibial artery, by making the incision at the inner and posterior edge of the tibia, is disapproved of by Mr. Guthrie on account of its difficulties. "The operator (says he) has cut his four inches, has turned up the edge of the gastrocnemius, and has insinuated his director under the head of the solæus, which he has also sliced away from the bone. The artery is still an inch inward, bound down by a strong fascia," which "must be cut immediately over, or by the side of the artery: it will not do to separate it from the bone, and then to push it over; it cannot be done." Then supposing the fascia to be divided in the best way, Mr. Guthrie deems the separation of the two veins from the artery, and the passage of the aneurism-needle under the artery from without inwards, so as to avoid the nerve, almost impracticable. "If a bystander should inquire why this most painful, difficult, bloody, tedious, and dangerous operation is done, the answer would be, solely because it was not usual to make a longitudinal incision in the muscles of the calf of the leg,— an incision, which, if made by accident, would be pronounced to be one attended with little danger, and not likely to lead to any subsequent detriment." (See *Guthrie, On Inj. and Dis. of Art.* p. 259.)

Instead of this method, Mr. Guthrie advocates the following: — An incision is to be made, six or seven inches in length, through the integuments and muscles of the calf down to the fascia. If the case is a gun-shot wound, the centre of the incision is to be on a line with the shot-holes; or if they are diagonal to each other, between them. The smoothness of the fascia points it out; and the loose cellular membrane, connecting the divided muscles to it, allows the edges of this long incision to be easily separated and the fascia cut, so as to expose the nerve, artery, and veins. The tourniquet is now to be unscrewed, and the bleeding denotes where the artery is injured. The knife may be applied perpendicularly to the fascia, and the artery laid bare for three or four inches in extent. (P. 261.) Perhaps the length of the incision, as here described, is rather greater than actually necessary. Five inches will afford a great deal of room; but, where the muscles of the calf are very bulky, it will be requisite to make the wound long.

Ligature of the Peronæal Artery.—Here, in following Mr. Guthrie's directions, the incision should also be made through the muscles of the calf, towards the fibular side of the leg; and after the deep fascia under them has been divided, the artery will be found covered by the fleshy fibres of the flexor longus pollicis, at any point below three inches and a half from the head of the fibula. These fibres having been divided, the artery will be found close to the inside of the bone. Above the point specified, the artery lies upon the tibialis posticus, under the deep fascia interposed between it and the muscles of the calf. No nerve accompanies it.

Ligature of the Axillary Artery.—In proportion as this vessel approaches the hollow of the axilla, it gets nearer to the vein, and becomes surrounded by those nervous fasciculi, by means of which, one portion of the brachial plexus communicates with another. Hence, to cut down to the artery in this place in the living body, and to tie it separately, is acknowledged to be an arduous task. The difficulty is further increased by the distance of the vessel from the surface. Hence, M. Manec objects to any attempt being ever made to apyly a ligature to the artery between the pectoralis minor and the lower border of the subscapularis. Independently, says he, of the difficulties of the operation, this part of the axillary artery would be unfavourable to its success, on account of the several branches which are given off from it, near one of which the ligature must be placed.

Directly the axillary artery has arrived opposite the lower border of the great pectoral muscle, the difficulty ceases. Here the brachial plexus no longer exists; each of the different nerves arising from it has taken the course to its particular destination, and the artery is only covered by the integuments and fascia. Behind, it rests upon the tendons of the teres major and latissimus dorsi; in front, it corresponds to the coraco-brachialis, from which it is separated by the median nerve. At its inner side are the internal cutaneous nerve, and the axillary vein, which sometimes consists of two or three branches, and renders the dissection of the artery more tedious. Farther backward than the axillary vein are the ulnar and musculo-spiral nerves. The relation of these last nerves to the artery it is of great importance to recollect, in order that neither of them may be mistaken for the median nerve.

In the operation of taking up the extremity of the axillary artery, the patient should be placed upon his back, and the arm raised from the side. An incision, two inches and a half in length, is to be made six or eight lines behind the anterior margin of the axilla, through the skin and subcutaneous cellular tissue. A piece of the fascia is then to be lifted up with the forceps, and an opening made in it, by cutting transversely, close to the end of the forceps; then a director is to be passed into the opening, and the fascia slit up to the extent of the external wound. If the fascia be tough and dense, so as not to afford convenient room, Manec recommends the incision in it to be converted into a crucial one. These things having been accomplished, the further use of the knife is not necessary. The anterior edge of the wound being now lifted up, the coraco-brachialis will be seen, and the median nerve at its inner side. This nerve being detected, the artery will be found behind it.

M. Manec offers valuable cautions with reference to the manner of avoiding the serious mistake of supposing the ulnar or muscular spiral nerve to be the median. To escape this blunder, he very properly insists upon the prudence of proceeding backwards from the coraco-brachialis, for in doing so the first nerve arrived at is the median. (See *Manec, Traité de la Lig. des Artères*, fol. Paris, 1832, Expl. of pl. 6.) In the case of a wound, however, the surgeon has not exactly the choice of the place for the application of the ligature to the axillary artery. Here he must obey the rule of applying it to the wounded part of the artery, and putting one ligature above and another below the bleeding orifice; or if the artery be completely severed, both its extremities will require to be tied.

In taking up the axillary artery, when it is wounded, Scarpa believes that nothing tends more to embarrass the surgeon, than an injudicious smallness of the first incision through the skin and such other parts as conceal the wound in the artery. An assistant must compress the vessel, from above the clavicle, as it passes over the first rib. When the weapon has penetrated, from below upward, directly into the axilla, the surgeon is to make a free dilatation of the wound upon a director, or his finger. This must be done to a sufficient height to expose a considerable portion of the artery, and the precise situation of the wound in it.

When the weapon has pierced obliquely, or from above downwards, through a portion of the great pectoral muscle, into the axilla, Scarpa advises the surgeon to cut through the lower edge of this muscle, and enlarge the wound, on a director, or his finger, so as to bring fairly into view the injured part of the artery. The thoracic arteries, divided in this operation, must be immediately tied. The clots of blood are then to be removed, and the bottom of the wound cleaned with a sponge, by which means the opening in the axillary artery will be more clearly seen. As this vessel lies imbedded in the brachial plexus of nerves, the surgeon must take care to raise it from these latter parts with a pair of forceps, before he ties it. Two ligatures will be required; one above, the other below, the wound in the artery.

ARTERIOTOMY (from *ἀρτηρία*, an artery, and *τέμνω*, to cut). The operation of opening an artery, and taking blood away from the system in this manner, for the purpose of preventing, alleviating, or curing disease. The only arteries of any size, from which blood is ever taken in practice, are the trunk and branches of the temporal artery, which lie in such a situation, that after the due quantity of blood has been taken away, the bleeding can be readily stopped by compressing the wounded part of the vessel against the neighbouring portion of the cranium. A narrow sharp-pointed bistoury, or a lancet, a basin for the reception of the blood, a compress, and a roller, are the only things required. In general, it is best to open the trunk of the temporal artery; but sometimes its frontal or occipital branch will yield blood enough. When the part of the artery which the surgeon chooses to open lies near the surface, and its pulsation is very distinct, and even visible, it may be opened at once with a lancet. But, in many instances, it is better first to make a cut in the skin, and then puncture the vessel. In all cases, the surgeon should recollect, — 1st, That the temporal artery and its branches are covered by the skin, adipose cellular tissue, and a thin aponeurosis. 2dly, That the trunk of the artery divides in the temple, about fifteen lines above the zygoma, and is situated about four lines in front of the meatus auditorius. 3dly, That its frontal branch runs forward from its origin, and its occipital branch in the opposite direction. A good place for the puncture is about four lines above the zygoma. In taking away blood from the temporal artery, or one of its branches, the surgeon should never forget the fact, that the loss of arterial blood produces a more debilitating effect than that of venous; but, in many instances, the requisite quantity of blood cannot be drawn by this operation, as every surgeon of experience must have observed. In order to prevent the blood from trickling down over the bedding or clothes, when it does not issue in a jet, the French make a little gutter with a piece of card for conveying it into the basin. After the proper quantity of blood has been taken away, a graduated compress and the nodose bandage are applied. The latter consists of a simple band, four yards long and two fingers' breadth wide, rolled up into two heads of unequal size. The unrolled portion being applied over the graduated compresses that cover the wounded artery, the surgeon conducts the two heads, before and behind, to the opposite temple, where he crosses them, in order to return to the point of departure. He now gives them a turn or twist, which enables him to carry one over the summit of the head, and the other underneath the chin to the sound side, where they meet and cross, as in the first instance. Thence they are conducted in the same course to the point of departure; and a second twist being effected, they are conducted for the third time to the opposite temple; and, for the third time, returned also horizontally and knotted: being conducted finally, one over the vertex and the other underneath the chin, the bandage is terminated by a few circulars of the long head. (See *Cutler's Surgeon's Practical Guide in Dressing, and in the Methodic Application of Bandages*, p. 46. 12mo. Lond. 1834.) A graduated compress and a few turns of a roller round the forehead, temple, and occiput, are generally preferable to the foregoing bandage, the part of which extending under the chin is often very irksome to the patient. In a few cases, notwithstanding pressure, the blood bursts forth from time to time; and when this happens, it is best to cut the vessel completely across, which will enable its ends to retract and contract, and thus promote the process of nature in closing them. In three or four days the wound is generally healed, but occasionally an aneurism follows; an interesting memoir on which subject has been published by M. Desruelles. (See *Mém. de la Soc. Méd. d'Emulation*, t. ix. p. 277.) In one instance, Cavallini effected a cure by dividing the vessel and compression. (*Collez di Casi Chir.* t. ii. Firenze, 1762.) Sir Benjamin Brodie informed me of a case, which he treated successfully in a similar manner. In the course of the present year, 1836, a woman was under my care in the North London Hospital for a temporal aneurism, which followed cupping on the temple. As the blood found its way freely into the tumour, after one branch had been tied, I divided another, and applied a compress; the plan was then effectual. Sir Astley Cooper informed me of a temporal aneurism, which was produced by a person falling with his temple against the corner of a table.

M. Blandin had a patient, who, in consequence of arteriotomy, suffered acute pains, which extended to the top of the head, in the track of the superficial temporal nerve; this consequence, which is uncommon, may be relieved by lengthening the puncture, or incision, at each of its angles, or even cutting out a portion of the nerve. (See *Dict. de Méd. et de Chir. Pratiques*, t. xiv. p. 422.)

ARTERITIS. *Inflammation of an Artery.* As the coats of arteries possess vessels and nerves of their own, and have an organisation more or less similar to that of all the living textures of the body, they must be liable to inflammation, suppuration, ulceration, and gangrene, as well as other morbid changes, especially a deposit of calcareous or atheromatous matter, between the inner and middle coats. Arteritis, as contrasted with phlebitis, or inflammation of veins, is much less perfectly understood, so far as the symptoms and diagnosis are concerned. It is very certain, however, that the arteries are not so irritable as the veins, and, consequently, that arteritis is less frequent than phlebitis. Pathologists divide it into *acute* and *chronic*. The anatomical characters of the acute are, redness of the internal membrane of the artery affected, an effusion of plastic fibrine on its inner surface, thickening of its substance, and sometimes ulceration. When inflammation runs from a wound, or some other point of irritation, along the internal coat of an artery far towards the heart, it is like phlebitis; a formidable disease, rapidly producing great irritative fever, an extremely quick pulse, complete collapse, low delirium, and generally death. Arteritis, by completely obstructing a main artery and its principal branches, is sometimes a cause of mortification. The treatment of acute arteritis consists in bleeding, purgatives, diaphoretics, low diet, cooling diluent drinks, and perfect tranquillity. Digitalis, tartrate of antimony, and super acetate of lead, are also prescribed on the principle of calming the circulation; but, as Dr. Hope observes, they must be used with discretion. (See *Cyclop. of Pract. Med.* part ii. p. 149.) After the first violence of the inflammation has been checked, mercury is sometimes given, so as to excite gentle but quick salivation.

Chronic arteritis is more common than acute. The internal membrane becomes thickened, softened, and of a deep, dirty red colour. "These appearances (says Dr. Hope) are not uniformly diffused, but more marked in the vicinity of calcareous and other degenerations. Hence, some have supposed that these degenerations were the cause of the inflammation. There can be little doubt, that they tend, in many instances, to keep it up; but, it is highly probable that the degenerations themselves were originally caused by increased vascular actions of a chronic nature." (See *Cyclop. of Pract. Med.* part ii. p. 145.) — The formation of spontaneous aneurisms is now commonly believed to have its origin in chronic arteritis.

ASCITES (*ἄσκιτης*, from *άσκὸς*, a bottle). *Abdominal Dropsy*, especially that which consists of an effusion of serous fluid in the cavity of the peritoneum. (See Paracentesis Abdominis.)

ASPHYXIA (from *α* privative of, and *σφύξη*, the pulse). Cessation of the action of the heart from the interruption of respiration; or rather of the effect produced by that function on the blood.

Asphyxia may also be defined to be a suspension of the phenomena of respiration, occurring primarily, and followed by that of all the other functions, and frequently by death. The general causes of asphyxia may be arranged under three principal heads. 1. Asphyxia from deficiency of air. 2. From the air being unfit for respiration, yet not producing any deleterious effect on the economy. 3. From the inspiration of some gas which is deleterious. As M. Duvergie rightly observes, however, the suspension of functions, or the mode of death in the last case, is very different from what is exemplified in the two first; because it is, in fact, a kind of poisoning, brought about by the action of a deleterious principle, either on the nervous system, or the blood, and the individual may perish, though he is actually respiring air. (*Duvergie*, in *Dict. de Méd. et de Chir. Prat.* art. Asphyxie.)

Cases of Asphyxia admit of a classification, first, into those into which there is primarily a stoppage of the mechanical phenomena of respiration; and, secondly, into others in which the chemical phenomena are primarily interrupted. As examples of the first mode of asphyxia, it will suffice to mention those in which the muscles of inspiration cannot act. 1. This happens where a heavy mass of earth, or other materials, suddenly falls upon a man, and makes great pressure on the chest, or abdomen. 2. Where the nervous influence does not extend to these muscles, as where the medulla spinalis is injured high up, or the phrenic nerves have been paralysed by the effect of lightning. 3. Where the same muscles are in a state of inaction from the influence of intense cold. Asphyxia, from the passive expansion of the lungs not taking place, may be exemplified in cases where the abdominal viscera are forced through an accidental or natural opening of the diaphragm into the chest, or when the lungs are compressed by fluid in the cavity of the pleura, and various other causes.

Asphyxia depending upon the primary cessation of the chemical phenomena of respiration is of two kinds. In one, it arises from some mechanical impediment to the entrance of air into the lungs, as in cases of foreign bodies entering the trachea, submersion, hanging, &c.; in the other, it depends upon a deficiency of air fit for the purposes of respiration.

Asphyxia may be the original affection, or it may be only the termination of another disorder. Thus, a person is attacked by pneumonia, and dies of asphyxia, caused by hepatisation of the lungs; or, he is seized with pleurisy, and is ultimately destroyed by an effusion of serous fluid in the chest. (See *M. Duvergie*, in *Dict. de Méd. et de Chir. Prat.* art. Asphyxie.)

As the salutary effect of respiration depends upon the air, which is respired, containing a due proportion of free oxygen, the deficiency or absence of this element must necessarily produce asphyxia. On this principle, azote, hydrogen, carbonic acid gas, and air too highly rarified, will cause asphyxia. Carbonic, and some other gases, act fatally also, on the principle of being positively deleterious to life, when introduced into the air-cells. One manner in which asphyxia may be occasioned, is by submersion, the lungs of warm-blooded animals not having an organisation, qualifying them to derive from the oxygen contained in water the salutary influence on the blood, which they collect from the respiration of atmospheric air.

Asphyxia may likewise arise from various circumstances preventing the entrance of air into the lungs; as, the lodgment of a foreign body in the larynx, trachea, orœsophagus; a swelling of the membrane of the larynx; obstruction of this organ and the trachea with fibrine, as in croup; tumours formed near, or pressing upon, some part of the respiratory tube, and pressure upon the same organ from any other cause, as is exemplified in strangulation. It has been explained that some causes of asphyxia operate by destroying the mechanism of respiration; that is, by rendering the muscles concerned in this function paralytic. Thus an injury of the medulla spinalis, as high up as the third cervical vertebra, by destroying the influence of the phrenic nerves, will paralyse the diaphragm. It will, at the same time, paralyse the other principal muscles concerned in producing the requisite changes in the dimensions of the chest; and, consequently, a fatal asphyxia must take place. This was well illustrated in a case lately brought into the North London Hospital. The ends of the neck-handkerchief of a youth, aged fifteen, were caught by the wheel of some machinery, which drew his neck with great force against the works, and at the same time caused violent strangulation. In about one minute the handkerchief was cut through, and the constriction removed: he was brought to the hospital with his respiration stopped, and asphyxia from this cause. Attempts were made to restore respiration, and the action of the heart, first, by blowing air into the lungs, through the nostrils. Whenever this was done, the action of the heart returned, the pulse rose, and the livor of the lips and countenance disappeared; but, as soon as the inflation of the lungs was discontinued, then the pulse sunk so as to become undistinguishable, and the skin assumed the purple colour again. Finding that this happened repeatedly, a suspicion was entertained that the cervical vertebræ had sustained injury; but, in order that the inflation of the lungs might have every chance of doing good, in the event of other injury not existing, I performed tracheotomy, and air was introduced into the lungs with a pair of bellows and a tube. All this, however, was in vain; and galvanism was equally unsuccessful. The boy was kept in a state exhibiting signs of life, for about six hours from the period of the accident; but, his temperature continuing to get lower and lower he at length sunk. In the *post mortem* examination, a fracture of the arch of the third cervical vertebra, a laceration of the front ligament of the spine, an effusion of blood on the medulla, and also another effusion behind the pharynx, were detected.

Formerly, the cessation of the action of the heart in hanging, or drowning, was referred to a mechanical impediment to the transmission of blood through the lungs to the left cavities of the heart. But the experiments of Goodwyn, and others, prove, that no such mechanical obstruction exists; and that, even after the fullest expiration, the air, remaining in the air-vesicles of the lungs, distends them sufficiently to permit the blood to circulate freely through them. The real obstacle arises out of the interruption of those chemical changes which atmospheric air produces on the blood while circulating in the pulmonary vessels, and which convert it from venous to arterial blood. In fact, the blood, which in asphyxia thus retains its venous character, does, for a time, pass through the pulmonary circulation, and is conveyed into the left ventricle, which propels it into the aortic system of arteries. But, this blood, which is thus substituted for arterial, has deleterious properties, depriving the organs, to which it is sent, of the power of performing their respective functions. Sensibility, irritability, together with all the physical and vital actions depending upon them, are suspended. (See *Roget*, in *Cyclop. of Pract. Med.*, art. Asphyxia.) From the investigations of Bichat, it appears that the primary effect of the circulation of venous, or what he calls black blood, is on the brain, and that this effect extends, through the intervention of the brain, to the whole nervous system. Loss of sensibility, therefore, precedes the suspension of the action of the heart, and takes place as soon as the venous blood, sent into the arteries, reaches the brain. (See *Bichat, Recherches sur la Vie et la Mort.*)

The face of a person who has been drowned is, in general, pale, though slightly livid. A frothy liquid, and some water, are found in the trachea, bronchi, and air-cells of the lungs: the latter organs are of a violet colour, but contain less blood, than where asphyxia has been occasioned by carbonic acid gas; the right auricle and ventricle are filled with black blood; in the stomach there is generally more or less water, which has been swallowed; the surface of the brain is of a darker appearance than usual, but its vessels not particularly turgid; and the air remaining in the lungs contains little oxygen. (*J. F. Berger, Essai sur la Cause de l'Asphyxie par Submersion.* Genève, 1805.; *Goodwyn, On Connection of Life with Respiration*, p. 19.)

When the person, at the time of falling into the water was intoxicated, stunned by a blow on the head, or in a state of syncope, there can have been no struggle. Under such circumstances, the trachea will contain a little water, but no froth; the lungs will be of their natural colour, and not much expanded; no water will be found in the stomach; and the blood in the venous system will not be so disproportionate to that contained in the arterial. As Dr. Roget justly observes, the great diversity in these and other circumstances "will enable us, perhaps, to explain the differences that are met with in the time, during which the body may remain under water, compatibly with the possibility of restoring life. If the submersion have not exceeded five minutes, and no blow against a stone or other violence has occurred to complicate the effects, our efforts at resuscitation, if properly conducted, will generally be successful. After a quarter of an hour, recovery is not very common; after twenty minutes, or half an hour, it may be considered as nearly hopeless. The longest period, recorded in the Reports of the Humane Society, is three quarters of an hour. On the other hand, some, who have only been a few minutes under water, cannot be restored to life, even by the prompt application of proper means." (*Dr. Roget*, in *Cyclop. of Pract. Med.*, art. Asphyxia.)

In the endeavour to resuscitate a person whose animation has been suspended by immersion, the wet clothes should be promptly removed, and the body covered with blankets, and placed on a table, with the head and chest raised; the nostrils and mouth are to be freed from froth, and kept perfectly unobstructed. The lungs are then to be inflated with the kind of bellows employed by the Humane Society, and provided with a short flexible tube, one end of which is adapted to the nozzle of the bellows, and the other to a silver tube, designed for introduction into the nostril. As the glottis is open, air, conveyed into one of the nostrils, while the other and the mouth are closed, and the larynx is pressed towards the vertebræ, so as to close the œsophagus, must necessarily pass into the lungs. The lungs being thus filled, are next to be emptied, by an assistant compressing the chest, and expelling the air. The same operations are to be repeated until natural respiration begins, or until this and other approved measures have been tried, at least, six hours. (*Dr. Curry, Obs. on Apparent Death, &c.*) When this method fails to fill the lungs with air, tracheotomy may be performed; but, in the opposite case, it is not necessary. As the body is insensible, there is, indeed, commonly, little or no difficulty in passing any bent tube of moderate diameter and proper length into the glottis, when the tongue is drawn forwards, and tracheotomy, under these circumstances, cannot be needed. Thus, with an ordinary silver catheter, air may be blown into the lungs. Together with inflation of the lungs, gentle friction of the body with warm flannels or the hand, stimulating the nostrils with hartshorn, and injecting warm stimulating fluids into the stomach with a syringe and tube passed down the œsophagus, are plans generally recommended. Slight shocks of electricity, or galvanism, through the heart and diaphragm, may also be tried, if the apparatus be ready at hand.

After the breathing has been restored, the patient is to be watched, lest he yet fall a sudden victim to a returning accumulation of black blood in the brain, or to the violent effects of reaction in the system.

The treatment of persons whose animation is suspended by *strangulation*, is the same as that of persons in a similar condition from submersion. Here, however, the fulness of the sinuses of the brain may render bleeding indispensable.

In cases of asphyxia depending upon obstruction of the glottis, larynx, or trachea, by disease, foreign bodies, or tumours, tracheotomy or laryngotomy, according to circumstances, is frequently the only means by which life can possibly be saved. (See LARYNGOTOMY and TRACHEOTOMY.)

The treatment of asphyxia from carbonic acid gas, consists in removing the body immediately into the fresh pure air, sprinkling it with cold water, if its temperature be high, galvanising it, and endeavouring to restore the breathing, by blowing air down the glottis: oxygen gas, if at hand. Differences of opinion are entertained about the utility of bleeding. (See *Goodwyn's Connection of Life with Respiration*, Lond. 1788. *A. Portal, Obs. sur les Vapeurs Méphitiques sur les Noyés, &c.* 8vo. Paris, 1787. Also, *Instructions sur le Traitement des Noyés*, Paris, 1811. *W. F. Edwards, De l'Influence des Agens Physiques sur la Vie*, 8vo. 1824. *Bichat, Recherches sur la Vie et la Mort*, 8vo. Paris. *Babington*, in *Med. Chir. Trans.* vol. i. *Coleman, On Natural and Suspended Respiration*, ed. 2. 1802. *James Curry, M.D., Obs. on Apparent Death from Drowning, &c.* ed. 2. 8vo. 1815. *P. M. Roget, M.D.* in *Cyclop. of Pract. Medicine*, art. Asphyxia. *Reports of the Royal Humane Society.* Also, *Détail des Sociès de l'Etablissement faite en faveur des Personnes Noyées.* Paris, 1773. *Marc des Moyens de Constater la Mort, par Submersion.* Paris, 1808. *Orfila, Secours à donner aux Personnes empoisonnées, ou Asphyxiées*, ed. 3. Paris, 1825. *J. Leroy, Recherches Expér. sur l'Asphyxie*, 8vo. Paris, 1829. *P. A. Piorry, Nouv. Expér. sur les Effêts de l'Insufflation de l'Air dans les Poumons, &c. Journ. Hebdom. de Méd.* t. iii. 1829.)

ATHEROMA. (From ἀθήρα, pap.) An encysted tumour, so named from its contents being of the consistence of pap. (See TUMOURS, ENCYSTED.)

ATROPHY. (From α privative, and τροφή, nutrition.) A deficiency in the nutritive powers of a part, in consequence of which its natural dimensions are reduced, and the number of its constituent molecules diminished. (*Townsend*, in *Cyclop. of Prac. Med.* art. Atrophy.) According to another pathologist, atrophy is degeneration of growth, deficiency in the size and weight of a part, and commonly of one or more of its usual constituents in particular. (*Mayo, Outlines of Human Pathology*, p. 16.) When the functions of organs cease, or are long suspended, an atrophy of them usually follows. Thus in a limb, kept for a long while unexercised in consequence of disease, the bones suffer atrophy, as well as the soft parts. But certain states of disease and injury, frequently lead to atrophy of various organs and textures. This fact is often exemplified in the testicle. Wounds of the occiput and back of the neck were remarked by Larrey, in Egypt, to be often followed by atrophy of this organ. The want of a free supply of blood and nervous energy, leads necessarily to weakness and atrophy of parts. In old age, various parts undergo what is termed *senile atrophy*. Thus, in advanced life, the ovaries and mammary glands are reduced to mere rudiments.

According to Dr. Carswell, atrophy "is the modification of bulk, which takes place in consequence of a diminution in the quantity of the solid materials which enter into the healthy composition of organs and tissues." This diminution of bulk, which constitutes the essential physical character of atrophy, is described by him as depending upon diminished exercise of the nutritive functions. (See *Carswell's Illustrations of the Elementary Forms of Disease*, p. 10.) In this valuable work, one of the most correct ever published on this interesting branch of pathology, notice is taken of certain forms of *congenital atrophy*, as exemplified in *monstrosities*, and occurring as the consequences of the formative process having been arrested at certain periods of the evolution of particular organs. Dr. Carswell next adverts to the atrophy, or even total disappearance of organs, soon after birth, which performed functions essential to the existence of the fœtus, but which are now no longer necessary to the maintenance of life; as the ductus arteriosus, umbilical arteries, the thymus gland, supra-renal capsules, &c. Different from these two forms of atrophy is that which, as Dr. Carswell observes, takes place in advanced life, "as the fulfilment of a general law of nature, so conspicuously manifested in the limited duration of all organised beings, which, having attained the maximum of their development, decline, after a variable period of time, and tend gradually towards decay." *Senile atrophy*, as Dr. Carswell terms it, is carried to a great extent in the vesicular structure of the lungs, the spongy structure of the penis, the testes, the lymphatic and mammary glands, the uterus, and ovaries. The bones in general lose much of their weight; and, as every surgeon of experience knows, fracture of the neck of the thigh-bone is rendered common in old persons, in consequence of the effects of senile atrophy. After seventy, the brain is diminished from $\frac{1}{15}$ to $\frac{1}{20}$ of its average weight, and becomes specifically lighter, and the trunks and branches of the nerves are reduced in size. The muscles, especially those of voluntary motion, participate likewise in the general decay: and so do the blood-vessels, which always bear a relation to the increased or reduced size of the organs to which they are distributed.

This fact is exemplified in the size of the large, or the number of small arteries being lessened. The general interstitial absorption of John Hunter, the atrophy of the whole body, or the marasmus and emaciation from diseases deranging the important functions of digestion, respiration, and the qualities of the blood, from fevers, profuse suppuration, and various severe and organic diseases, I need not consider in this place. But, besides these forms of atrophy affecting the whole body, there are others which are local, and divided by Professor Carswell into three classes. 1. Atrophy from a diminished supply of blood. 2. From diminished exercise of the function of innervation. 3. From diminished exercise of the functions of the organ. For numerous original, philosophical, and practical remarks on these heads, I refer to *Carswell's Illustrations of the Elementary Forms of Disease*, fasc. 10.

AUSCULTATION. Mediate auscultation, or the method of judging of the nature and conditions of various diseases by the particular sound which they communicate either to the unassisted ear, or to that organ, through the medium of the *stethoscope*. Thus, in diseases of the lungs and pleura, the practitioner may derive important information respecting the condition of those organs, by attending minutely to the changes in the sound of respiration, to the sound of the voice and coughing within the chest, and to what is called the *rattle*, and other sounds occasionally heard in the same situation. The stethoscope, then, in many ambiguous cases, must be deemed an instrument of great importance in practice. For a particular description of it, however, I refer to Laennec's invaluable work on diseases of the chest, in the translation and improvement of which, by numerous instructive notes, Dr. John Forbes has rendered himself a benefactor to medical science. In surgery, the stethoscope is usefully employed in detecting the real nature of various doubtful swellings, particularly those of the aneurismal character. By M. Lisfranc it has been found of considerable service, in enabling him to judge with more accuracy of the collision of the sound against calculi, or other substances in the bladder, in the operation of sounding. M. de Kergaradac has used the stethoscope with much success for ascertaining pregnancy, where the history was obscure. It has also been found of great utility in determining the existence and state of various collections of fluids, and particularly of pus; and it has enabled practitioners to ascertain, with certainty, the communications occasionally existing between abscesses of the liver and the interior of the lungs, as well as the occasional communication of pulmonary abscesses with the abdominal cavity. In cases of fracture, where the crepitus is obscure, the stethoscope removes all ambiguity. In all diseases about the heart, and large blood-vessels near this organ, much useful information may be derived from it; but, the method of using it, and the circumstances by which it affords instruction, must be gathered from a careful perusal of Laennec's and other works.

De l'Auscultation Mediate, vol. ii. 8vo. Paris, 1826, ed. 2. *Lejumeau de Kergaradac*, Mem. sur l'Auscultation, 8vo. Paris, 1822. *J. Lisfranc*, Mém. sur des Nouvelles Applications du Stethoscope, 8vo. Paris, 1823. *J. Forbes*, M.D., Original Dissections, &c. illustrating the Use of the Stethoscope, 8vo. Lond. 1824. Also, the Notes in his Transl. of Laennec, On Dis. of the Chest. *W. Stokes*, Introduction to the Use of the Stethoscope, 8vo. Edinb. 1825.; also, *P. A. Piorry*, De la Percussion Mediate, &c. 8vo. Paris, 1828. *P. M. Latham*, M.D., Lectures on Subjects connected with Clinical Medicine, vol. i. 8vo. 1836.

BALSAMUM COPAIVÆ. Its properties closely resemble those of turpentine. Exhibited by surgeons principally in gonorrhea, gleet, fluor albus, piles, and some diseases of the bladder. The common dose is from ten drops to half a drachm, two or three times a day. Mr. Brande gives the following formula:—℞ Mucil. Acaciæ ʒss Copaibæ ss tere simul et adde gradatim Aq. Menth. vir. ℥j. Tinct. Capsici mv. ♏. ft. Haustus bis vel ter quotidie sumendus. (See *Manual of Pharmacy*, p. 70.) Copaivæ may also be given in a solid form. For this purpose it may be combined with an alkali and made into a soap, which can be made into pills, the dose being from gr. xii to ℈j. (See *A. T. Thomson's Mat. Med. and Therapeutics*, p. 859. ed. 2.)

BANDAGE. The use of bandages is to keep dressings, compresses, remedies, &c. in their proper situation; to compress blood-vessels, so as to retain hemorrhage; to rectify certain deformities by holding the deranged parts in a natural position; to unite parts in which there is a solution of continuity; and, in particular, to prevent such parts from moving, or quitting the desirable position. As the application of bandages is an important branch of surgery, authors have not neglected it. Much has been written on the subject, and almost every writer has devised new bandages, perhaps, without real benefit to the art. Unfortunately, it is next to impossible to give clear ideas of the numerous sorts of bandages by a printed description of them, especially when it is not accompanied by diagrams or engravings. The surgeon can only acquire all the necessary instruction from experience and practice. Hence, I shall confine myself to a general account of the subject.

Bandages should be made of materials, possessing sufficient strength to fulfil the end proposed in applying them, and at the same time, they should be supple enough to accommodate themselves to the parts. They are made of linen, cotton, or flannel. If possible, they should be without a seam, or selvage, which is likely to cause unequal and painful pressure.

In particular cases, a bandage should have a degree of firmness, that does not belong to the materials usually employed. This circumstance is exemplified in hernia, and in all examples in which there is occasion for elastic bandages. As already observed, linen, flannel, and cotton (calico), are the common materials. The first employment of flannel bandages is imputed to the Scotch surgeons, who preferred them to linen ones, in consequence of their being better calculated for absorbing moisture, while, being more elastic, they yield in a greater degree in cases requiring this property; as in the swelling subsequent to dislocations, fractures, &c. It has been asserted, that linen is better than flannel, because more cleanly; but neither one nor the other will continue clean, unless care be taken to change it often enough. Where the indication is to keep the parts warm, flannel is of course preferable both to linen and calico.

In applying a bandage, care must be taken that it be put on tight enough to fulfil the object in view, without running any risk of stopping the circulation, or doing harm in any other way. If it be not sufficiently tight to support the parts in a proper manner, it is useless; if it be too tense, it will produce swelling, inflammation, and even mortification.

In order to apply a roller skilfully, the part which is to be covered, must be put in its proper situation and position, while the head of the roller is held in the surgeon's hand, and only so much unrolled as is necessary for the commencement of the application.

In general, the bandage should be applied in such a manner as will admit of its being most conveniently removed, and allow the state of the subjacent parts to be examined, as often as occasion may require, with the least possible disturbance of them. Thus, when a broken leg is placed on M'Intyre's apparatus, three rollers are employed. One is applied to keep the knee steady; another to maintain the foot and lower part of the limb motionless; while the central one covers the fracture, and can be taken off, so as to let the fracture be examined, or a wound dressed, without any occasion to meddle with the other pieces of bandage, or disturb the fracture in the slightest degree. Hence, one cause of the remarkable success, with which fractures of the lower limbs are treated in the North London Hospital.

For the same reason, in fractures of the leg and thigh, the eighteen-tailed bandage is often preferred to a simple roller. The former may be loosened and tightened at pleasure, without occasioning the smallest disturbance of the affected limb; a thing which could not be done were a common roller to be employed in the ordinary way, with ordinary splints.

As soon as the bandage has fulfilled the object for which it is applied, and it has become useless, its employment should be discontinued; for, by remaining too long on parts, it may obstruct the circulation, diminish the tone of the compressed fibres and vessels, and thus do serious harm.

Bandages are either *simple* or *compound*. They are also sometimes divided into *general* and *particular*. The latter often derive their names from the parts to which they are usually applied.

A simple bandage is a long piece of linen or cotton, of an indefinite length, and from three to six inches in breadth. When about to be applied, it is commonly rolled up, and the rolled part is termed its *head*. When rolled up from each end, it is called a *double-headed roller* or *bandage*.

The chief of the simple bandages are the *circular*, the *spiral*, the *uniting*, the *retaining*, the *expellent*, and the *creeping*.

The *circular* bandage is the simplest; consisting merely of a few circles of a roller covering or overlapping each other.

The *spiral* bandage is the most frequently used of all; for it is this which is seen in such common employment on the limbs, in cases of ulcers, varices, fractures, &c. In applying a common roller to the whole of a limb, the bandage must be carried round the part spirally; for otherwise the whole member cannot be covered. When the leg is the part, the surgeon is to begin by surrounding the foot with a few turns. Then carrying the head of the bandage over the instep, he is to convey it backward, so as to make the bandage unroll, and apply itself just above the heel. The roller may next be brought over the inner ankle; thence again over the instep, and under the sole; and the surgeon then brings the bandage spirally upward once more to the outer part of the leg. After this, every circle of the roller is to be applied, so as to ascend up the limb in a gradual, spiral form, and cover about one-third of the turn of the roller immediately below it. The unequal diameter of the limb is one great cause, which brings into view the unskilfulness of a surgeon in this operation; for it prevents the roller from lying smoothly, although spirally applied, unless a particular artifice be dexterously adopted. The plan alluded to is, to double back the part of the roller that would not be even, were the application to be continued in the common spiral way, without this manœuvre. When the bulk of the limb increases very suddenly it is sometimes necessary to fold, or, as it is termed, *reverse* every circle of the bandage in the above manner, in order to make it lie evenly on the limb. It is manifest that the pressure of the roller will be greatest where the duplicatures are situated; and hence, when it is an object to compress any particular part, the surgeon should contrive to reverse the turns of the bandage just over the situation where most pressure is desirable.

When a roller is to be applied to the forearm, it is often best to put a few of the first turns of it round the hand.

Particular care must be taken not to make the bandage very tight, if it be intended to wet it afterwards with any lotion; for moisture always renders it still more tense.

Mr. John Bell describes the principal purposes for which a roller has been employed, as follows: "Although, in recent wounds, it is with plasters and sutures that we unite the parts point to point, yet it is with the bandage that we support the limb, preserve the parts in continual and perfect contact with each other, and prevent any strain upon the sutures, with which the parts are immediately joined; and we often unite parts by the bandage alone. But, it is particularly to be observed, that, in gun-shot wounds, and other bruised wounds, though it would be imprudent to sew the parts, since it is impossible that they should altogether unite, yet the gentle and general support which we give by a compress and bandage, prevents them from separating far from each other, unites the deep parts early, and lessens the extent of that surface which must naturally fall into suppuration.

"In the hemorrhagy of wounds, we cannot always find the artery; we dare not always cut parts for fear of greater dangers; we are often alarmed with bleedings from uncertain vessels, &c. or from veins as well as arteries: these hemorrhages are to be suppressed by the compress; which compress, or even the sponge itself, is but an instrument of compression, serving to give the bandage its perfect effect. Frequently, in bleedings near the groin, or the armpit, or the angle of the jaw, —wherever the bleeding is rapid, the vessels uncertain, the cavity deep, and the blood not to be commanded by a tourniquet, and where the circumstances forbid a deliberate and sure operation, we trust to compress and bandage alone.

"Bandage is very powerful in suppressing bleeding. At one period of surgery, it took place of every other method, &c. If a compress be neatly put upon the bleeding arteries, if there be a bone to resist the compress, or even if the soft parts be firm below, and the bandage be well rolled, the patient is almost secure. But such a roller must be applied smoothly from the very extremity of the fingers or toes; the member must be thoroughly supported in all its lower parts, that it may bear the pressure above. It is partial stricture alone that does harm, creates intolerable pain and anxiety, or brings on gangrene. Hemorrhagy requires a very powerful compression, which must therefore be very general, &c. It must not be made only over the bleeding arteries, which is all that the surgeon thinks of in general, &c.

"In abscesses, where matter is working downwards along the limb, seeking out, as it were, the weak parts, undermining the skin, and wasting it, insulating and surrounding the muscles, and penetrating to the bones, the bandage does every thing. The expelling bandage, the propelling bandage, the defensive bandage, were among the names which the older surgeons gave to the roller, when it was applied for these particular purposes; and these are properties of the roller, which should not be forgotten." (See *Principles of Surgery* vol. i.)

Soon after this description, in which the advantages of the roller in gun-shot wounds, and hemorrhage, are rather exaggerated, Mr. John Bell proceeds to explain in what manner this most simple of all bandages may be put on a limb.

"Practice will convince you, that the firmness and neatness of a bandage depend altogether upon these two points; First, upon the turns succeeding each other in a regular proportion; and, Secondly, upon making reverses, wherever you find any slackness likely to arise from the varying form of the limb. Thus, in rolling from the foot to the ankle, leg, and knee, you must take care, first, that the turns, or, as the French call them, *doloires*, of the roller lie over one another by just one third of the breadth of the bandage; and, secondly, that, at every difficult part, as over a joint, you turn the roller upon the limb, with the opposite flat side towards it: you must turn the bandage so as to reverse it, making what the French call a *renversée* of the roller at the ankle, at the calf of the leg, and at the knee. You must be careful to roll your bandage from below upwards, and support the whole limb by a general pressure. That you may be able to support the diseased part with a particular pressure, you must lay compresses upon the hollows and upon the bed of each particular abscess, and change the place of these compresses from time to time, so as now to prevent matter sinking into a particular hollow, now to press it out from a place where it is already lodged, and again to reunite the surface of an abscess already completely formed, from which the matter has been discharged." (*Principles of Surgery*, vol. i.)

In applying a roller to the leg, as Dr. Cutler observes, the turns cannot be laid down flatly, as the upper border will compress the salient part of the limb, while the lower one hangs loose. This inconvenience is obviated by reversing it at every turn, so that the inferior becomes the superior, and the external face the internal. The hand should press lightly over each reverse, so as to flatten it. Two things are to be observed in applying this reversed bandage; one is not to unroll, in making the angle, more of the band than is absolutely necessary; the other, to carry the angles upwards, in a perpendicular line, and always far from the part affected. (See *Cutler's Surgeon's Pract. Guide in Dressing*, &c. p. 18.)

In the article JOINTS, I have noticed the good effects of the pressure of the roller in the cure of some diseases of the knee. Here Mr. John Bell's sentiments upon the subject merit attention:—"In a diseased bursa, as in a relaxation of the knee-joint, that disease which, with but a little indulgence, a very little encouragement of fomentations, poultices, bleeding, and low diet, would end in white swelling of the knee, may be stopped even by so simple a matter as a well-rolled bandage." (Vol. i. p. 127.)

The *uniting bandage*, or *spica descendens*, used in rectilinear wounds, consists of a double-headed roller, with a longitudinal slit in the middle, three or four inches long. The roller having one head passed through the slit, enables the surgeon to draw the lips of the wound together. The two heads are then carried in opposite directions round the limb again, and when they meet another slit is made, through which one of them is passed. The same manœuvres are repeated, along the whole line of the wound. This bandage is a bad one; for it cannot be made to lie equally on the part. Neither can it be removed, without cutting it. Modern surgeons rarely employ it.

Heister, Henckel, and Richter, describe a sort of uniting bandage, that allows the surgeon to see the wound, over which only small ligatures cross.

When we make use of a single-headed roller, merely as a *retentive bandage*, we should remember always to begin the application of it on the side opposite the wound. The obvious reason for so doing is, to prevent a further separation of the lips of the wound, as the contrary manner of applying the roller would tend directly to divide them. (*Gooch*, vol. i. p. 143.)

The intention of the *expellent bandage* is, to keep the discharge sufficiently near the orifice of the wound to prevent the formation of sinuses. In general a compress of unequal thickness is necessary; the thinner part of the compress being placed next, and immediately contiguous to, the orifice of the wound; the thicker part below. Before the bandage is applied, the pus must be completely pressed out, and the rolling begin with two or three circular turns on the lower part of the compress. The bandage must then be carried spirally upwards, but not quite so tightly as below. It is afterwards to be rolled downward to the place where it began.

The *creeping* is a simple bandage, every succeeding turn of which only just covers the edge of the preceding one. It is employed in cases in which the object is merely to secure the dressings, and not to make any considerable or equable pressure.

A bandage is termed *compound*, when several pieces of linen, cotton, or flannel, are sewed together in different directions, or when the bandage is torn or cut, so as to have several tails. Such are the T bandage, the suspensory, the capistrum, &c.

The *eighteen-tailed bandage* is one of the most compound. This is in common use for fractures of the leg and thigh; sometimes, but not often, for those of the forearm, and, frequently, for particular wounds. Its great recommendation is the facility with which it can be undone, so as to allow the parts to be examined, and its not creating, on such an occasion, the smallest disturbance of the disease, or accident. In the North London Hospital, where M'Intyre's apparatus is employed for fractures of the lower extremities, the eighteen or many tailed bandage is not very often used.

The eighteen-tailed bandage consists of a longitudinal portion of a common roller, and a sufficient number of transverse pieces, or tails, to cover as much of the part as is requisite. Each of the cross pieces is to be proportioned in length to the circumference of the part of the limb to which it is to be applied; so that, in making this sort of bandage for the leg, or thigh, the upper tails will be twice as long as the lower ones. After laying the long part of the bandage on a table, fix the upper end of it in some way or another. Then arrange the tails across it, in sufficient number to cover such part of the limb as requires the bandage. Each tail must be long enough to extend about two inches beyond the opposite one, when they are both applied. The tails being all arranged across the longitudinal band, they are to be stitched in this position with a needle and thread. When the bandage is intended for the leg, a piece of the longitudinal part of the roller below is to extend beyond the tails. This is usually brought under the sole of the foot, and then applied over the inner ankle, directly after the bandage has been put under the limb. Then the surgeon lays down the first of the lower tails, and covers it with the next. In this way, he proceeds upward, till all the cross pieces are applied, the uppermost one of which he fastens with a pin. This bandage has a very neat appearance. The tails are said to lie better, when placed across the longitudinal piece a little obliquely.

The T *bandage* is, for the most part, used for covering parts of the abdomen and back, and, especially, the scrotum, perineum, and parts about the anus. Its name is derived from its resemblance to the letter T, and it is, as Mr. John Bell remarks, the peculiar bandage of the body. If the breast, or belly, be wounded, we make the transverse piece, which encircles the body, very broad; and having split the tail-part into two portions, one of these is to be conveyed over each side of the neck, and pinned to the opposite part of the circular bandage, so as to form a suspensory for the latter, and prevent its slipping down. But, says Mr. John Bell, if we have a wound, or disease, or operation, near the groin, or private parts, the tail-part becomes the most important part of the bandage: then the transverse piece, which is to encircle the pelvis, is smaller, while the tail-part is made very broad. When the disease is in the private parts, perineum, or anus, we often split the tail according to circumstances; but, when the disease is in one groin, we generally leave the tail-part of the bandage entire and broad.

The *scissum linteum*, or *split-cloth*, is a bandage applied occasionally to the head, and consists of a central part, and six or eight tails, or heads, which are applied as follows:—

When the cloth has six heads, the middle, or unsplit part of the cloth is applied to the top of the head. The two front tails go round the temples, and are pinned at the occiput; the two back tails go also round the temples, and are pinned over the forehead; the two middle tails are usually directed to be tied under the chin; but, as Mr. John Bell observes, this suffocates and heats the patient, and it is better to tie them over the top of the head, or obliquely, so as to make pressure upon any particular point. (*Principles of Surgery*, vol. i. p. 131.)

The old surgeons usually split this middle tail into two parts, a broad, and narrow one. In the broad one, they made a hole to let the ear pass through. This broad portion was tied under the chin, while the narrow ends were tied obliquely over the head. As Mr. John Bell has observed, though this gave the split-cloth the effect of eight tails, yet, the ancient surgeons did not name it the split-cloth with eight tails. When they split the cloth into eight tails, and especially when they tied the eight tails in the following particular manner, they called the bandage *cancer*, as resembling a crab in the number of its legs. The *cancer*, or *split-cloth of eight tails*, was laid over the head, in such a manner, that four tails hung over the forehead and eyes, while the other four hung over the back of the head. They were tied as follows:—first, the two outermost tails, on each side in front, were tied over the forehead, while the two middle tails in front were left hanging over the knot. Then the two outermost or lateral tails behind were tied round the occiput. Next the middle tails were tied, the two anterior ones being made to cross over each other, and pass round the temples, to be pinned at the occiput; while the two middle tails behind were made to cross each other, and pass round the temples, so as to be pinned over the ears, or near the forehead. (See *John Bell's Principles*, vol. i. p. 132.)

The *triangular bandage* is generally a handkerchief doubled in that form. It is commonly used on the head, and, now and then, as a support to the testicles, when swelled. The French term it *couvre chef en triangle.*

The *nodose bandage*, called also *scapha*, is a double-headed roller, made of a fillet four yards long, and about an inch and a half broad. It must be reversed two or three times, so as to form a knot upon the part which is to be compressed. It is employed for the stoppage of hemorrhage, or for securing the compress after the performance of arteriotomy in the temples. It is more particularly described in another place. (See ARTERIOTOMY.)

The most convenient bandage for the forehead, face, and jaws, is the *four-tailed one* or *single split-cloth.*

It is composed of a strip of cloth, about four inches wide, which is to be torn at each end, so as to leave only a convenient portion of the middle part entire. This unsplit middle portion is to be applied to the forehead, if the wound be there, and the two upper tails are carried backward, and tied over the back part of the head, while the two lower ones are to be tied either over the top of the head, or under the chin, as may seem most convenient.

When the wound is on the top of the head, the middle of the undivided part is to be applied to the dressings. The two posterior tails are to be tied forward, and the two anterior ones are to be carried backward, so as to be tied behind the head. This is sometimes called *Galen's bandage.* It is curious, that writers on bandages should use the terms *head* and *tail,* synonymously; and hence this *four-tailed bandage* is often called the *sling* with *four heads.* Such confusion of language is highly reprehensible, as it obstructs the comprehension of any, the most simple, subject.

If the upper lip be cut, and a bandage needed, which is seldom the case, it is almost superfluous to say that this bandage will serve the purpose. It serves also in cuts of the lower lip, though in them, also, we trust rather to the twisted suture than a bandage.

The single split-cloth is particularly useful for supporting a fractured lower jaw; and, in such cases, is the only one employed in modern surgery. This bandage, when used for this particular purpose, namely, supporting the lower jaw, is named *capistrum,* or *bridle,* because it goes round the part somewhat like a bridle.

"In some cases (says Mr. John Bell), the circumstances require us to support the chin particularly, and then the unslit part of the bandage, is applied upon the chin with a small hole to receive the point; but, where the jaw is broken, we pad up the jaw-bone into its right shape, with compresses pressed in under the jaw, and secured by this bandage. When we are in fear of hemorrhage after any wound, or operation, near the angle of the jaw, we can give the sling a very remarkable degree of firmness. For this purpose, we tear the band into three tails on each side, and we stitch the bandage at the bottom of each slit, lest it should give way, when drawn firm," &c. (*Principles of Surgery,* vol. i.)

We have already described one way of applying a handkerchief, as a bandage to the head, in our notice of the *triangular one* or *couvre chef en triangle.* The other manner of applying the handkerchief, called the *grand couvre chef,* is as follows: —

You take a large handkerchief, and fold it, not in a triangular, but a square form. You let one edge project about three finger-breadths beyond the other, in order to form a general border for the bandage. You lay the handkerchief upon the head, so as to make the lower fold, to which the projecting border belongs, lie next the head; while the projecting border itself is left hanging over the eyes, till the bandage is adjusted. The two corners of the outermost fold are first to be tied under the chin; the projecting border is then to be turned back, and pinned in a circular form round the face, while the corners of the fold next the head are to be carried backward and tied.

After the outer corners of this bandage have been tied under the chin; after the inner corners have been drawn out and carried round the occiput; and after the border has been turned back and pinned; the doubling of the handkerchief over each side of the neck hangs in a loose, awkward manner. It remains, therefore, to pin this part of the handkerchief up above the ear, as neatly as can be contrived. (See *J. Bell's Principles.*)

The grand couvre chef has certainly nothing to recommend it, either in point of utility, or elegance. A common nightcap must always be infinitely preferable to it. In the event, however, of a cap not being at hand, it is proper that the surgeon should know what contrivances may be substituted to fulfil the objects in view.

Having, in numerous articles of this Dictionary, noticed the mode of applying bandages in particular cases, and allotted a few separate descriptions for such bandages, as are not here mentioned, but which are often spoken of in books, we shall conclude for the present with referring the reader for further information to *Rees's Cyclopædia; John Bell's Principles of Surgery,* vol. i. *Dict. des Sciences Méd: art. Bandage.* Galen and Vidus Vidius are reckoned the best of the old writers on the subject; M. Sue, Thillaye, Heister, Juville, Lombard, Bernstein, J. Bell, and Cutler, of the modern ones. The Treatise of the latter is entitled *The Surgeon's Practical Guide in Dressing and in the Methodic Application of Bandages,* 12mo. London, 1834. Illustrated by numerous engravings.

BARK, PERUVIAN. (See CINCHONA.)

BELLADONNA. (*Deadly Nightshade.*) A powerful sedative and narcotic. The leaves were first used externally for discussing scirrhous swellings, and they have been subsequently given internally, in scirrhous and cancerous diseases, amaurosis, &c. Five grains of them dried are reckoned a powerful dose; one is enough to begin with. At present, the extract, in doses of half a grain, gradually increased to three, is more commonly prescribed.

It is said that the recent leaves powdered, and made into an ointment with an equal weight of lard, more effectually prevent priapism, and relieve chordee, when rubbed on the penis, than any other application. (*Paris's Pharmacologia,* vol. ii. p. 110, ed. 5.)

In neuralgia of the testicle, breast, and other parts, the use of the extract of belladonna, in the form of a plaister is well known.

From the power which belladonna is known to possess, of lowering the action of the whole arterial system, it seems to be a fit medicine in many surgical cases, where that object is desirable, particularly in examples of aneurism.

An ointment, composed of one drachm of the extract, and seven drachms of lard, and rubbed on the perineum, affords great relief in hemorrhoids, and chordee. (See *A. T. Thomson's Mat. Med. &c.* p. 433, ed. 2.) It may also be applied directly on the tumours, or the induration itself.

Belladonna has the power of producing a dilatation of the pupil, when applied to the eyebrow and eyelids. The late Mr. Saunders, a little while before undertaking the operation for the congenital cataract, was accustomed to introduce some dissolved extract of belladonna between the eyelids, or rub the eyebrow and skin about the eye freely with the same application. The consequence was, that, if there were no adhesions of the iris to other parts, a full dilatation of the pupil was produced in less than an hour, and the whole of the cataract was distinctly brought into view. This was unquestionably a considerable improvement in practice, as the iris was kept out of danger, and the operation materially facilitated. I allude here more particularly to Mr. Saunders's own method, in which he introduced the needle through the cornea, in front of the iris, and then conveyed it to the cataract through the enlarged pupil. Belladonna was also externally applied by Mr. Saunders, after the operation, with the view of preventing the edge of the iris from becoming adherent to the edges of the torn capsule. The influence of belladonna on the iris led also Professor Reimarus to propose its use for facilitating the extraction of the cataract. In iritis, the same plan is an important part of the treatment. It must, however, be admitted, that the iris, when much altered by inflammation, is not affected by belladonna; but, even under such circumstances, its use is not attended with any disadvantage. But it is not from its effects on the pupil alone, that the extract of belladonna should be applied. Very decided relief is obtained from its application in cases where there is a deep-seated pain, extending from the eyeball to the temple and especially in rheumatic inflammation. It may be used as recommended by Beer, in the form of ointment, rubbed in upon the temple (half a drachm of the extract, with an equal quantity of mercurial ointment every night), or the extract alone, softened with water and daubed over the lids and brow, and kept moist for one or two hours, with a light fold of old linen, wetted every ten minutes, may be preferred. (See *Jacob* in *Trans. of Assoc. of Physicians of Coll. Ireland*, vol. v. p. 476.) Whenever the state of the eye, behind the pupil, requires to be minutely examined, the plan of dilating this aperture by means of belladonna, very materially facilitates the examination. Stramonium is found to have the same effect upon the iris as belladonna. Some experiments, in which the fact is clearly proved, were detailed many years ago, by a namesake of my own in the United States. (See *A. Diss. on the Properties and Effects of the Datura Stramonium, &c. by Samuel Cooper*, Philadelphia, 1797. *C. Himly, De la Paralysie de l'Iris par une application locale de Jusquiame, &c.* 2d. ed. 12mo. Altona, 1805. *J. Bailey, Obs. relative to the Use of Belladonna in painful Disorders of the Head and Face*, 8vo. Lond. 1818.)

BINOCULUS (from *binus*, double, and *oculus*, the eye). A bandage for keeping dressings on both eyes. Its application will easily be understood by referring to *Monoculus*.

BISTOURY. (*Bistoire*, French.) Any small knife for surgical purposes.

BLADDER, PUNCTURE OF. The making of an artificial outlet for the urine is an operation to which we are sometimes obliged to have recourse, after having in vain employed all the other means indicated for the prevention of the bad, and even fatal, consequences of a stoppage of the evacuation of this fluid, and distension of the bladder. Various accidents and diseases, both acute and chronic, may occasion this dangerous state, as will be more particularly noticed in the article URINE, RETENTION OF. In some cases, however, the artificial outlet is not made, at the present day, so frequently by puncturing the bladder, as by opening the distended part of the membranous portion of the urethra, behind the stricture.

The bladder, which can conveniently hold about a pint and a half of urine, is no sooner dilated, so as to contain two pints, than uneasy sensations are experienced. The desire of discharging the water now becomes urgent, and if the inclination be not gratified, and the bladder be suffered to be dilated beyond its natural state, for a certain time, it loses all power of contraction, and becomes paralytic. The desire, indeed, continues, and the efforts are renewed in painful paroxysms; but, the power is lost, and the bladder becomes more and more distended. When this viscus is dilated in the utmost degree, and neither its own structure, nor the space in the abdomen, can allow a further distension, either the bladder must be lacerated, which it rarely is, so equally is it supported by the pressure of the surrounding parts, or its orifice must expand and the urine begin to flow. After the third day of retention, the urine often really begins to flow, and whatever descends from the kidneys is evacuated in small quantities from time to time, and at this period, the bladder is distended in as great a degree as it ever can be, however long the patient may survive. This dribbling of the urine, which begins when the bladder is dilated to the utmost, and continues till the eighth or tenth day, or till the bladder sloughs, has long been understood, and is named by the French, "*Retention par régorgement.*" To practitioners, who do not understand it, the occurrence is most deceitful. The friends felicitate themselves, that the urine begins to flow; the surgeon believes it; basins and cloths wet with urine are easily produced; but the patient lies unrelieved. The continued distension of the bladder is followed by inflammation of it and the peritoneum. The insensibility, and low delirium of incipient gangrene, are mistaken for that relief, which was expected from the flow of urine, till either hiccough comes on, and the patient dies of fever and inflammation, or the urine gets into the abdomen through an aperture, formed by mortification. Let no surgeon, therefore, trust to the reports of nurses and friends, but lay his hand upon the hypogastric region, and tap with his finger, in order that he may distinguish the distended bladder, and the fluctuation of urine. As the bladder suffers no further distension after the third day, why should it burst? Not from laceration; for it is supported by the uniform pressure of the surrounding viscera; not by yielding suddenly, for it is distended to its utmost on the third day of the retention, and yet seldom gives way before the tenth; not by attenuation, for it becomes thickened. The term *laceration* was never more wrongly applied, than in this instance; for, when there is a breach in the bladder, it is found, on dissection, to be a small round hole, such as might be covered with the point of the finger. The rest of the viscus, and the adjacent bowels, are red and inflamed, while this single point is black and mortified! Delay is more dangerous than even the worst modes of making an opening into the bladder; and, while life exists, the patient should have his chance. (See *John Bell's Principles of Surgery*, vol. ii. part 1. p. 262, &c.) That many patients die after paracentesis of the bladder is an undoubted truth, and this circumstance has rather intimidated practitioners against the operation. It appears to me, however, that in general death may be more fairly ascribed to the effects of the disease, than to the puncture of the bladder, and that, if the making of an outlet for the urine, in some way or another, were not deferred so long as it often is, the recoveries would be more numerous. Hence, when relief cannot be obtained by the treatment described in the article URINE, RETENTION OF; when no urine at all has come away for three days, and no catheter can be introduced, the making of an outlet for the urine should not be delayed. Indeed, in urgent cases, one should rather operate earlier. Indeed, as Sir Benjamin Brodie has observed, it is impossible to lay down any general rule concerning the period, beyond which the operation ought not to be deferred. "Sometimes there will be no reason for resorting to it, until after the lapse of three or four days, and, at other times, it ought to be performed within thirty-six hours, or even sooner. After all, however necessary it may be to the safety of the patient in some instances, it is an operation that is very rarely required; surgeons, who see a great number of cases of retention of urine, may be called upon to perform it in a *few* instances. Those who perform it frequently, must often perform it unnecessarily. (See *Brodie* on *Dis. of the Urinary Organs*, ed. 2. p. 41.) These remarks, I infer, apply more particularly to puncturing the bladder, and not to the less serious operation of opening the membranous part of the urethra behind the urethra; one of the modern improvements of surgery, for which we are indebted to Sir Astley Cooper, and which, in cases of insuperable retention from stricture, renders a puncture of the bladder itself but rarely advisable. Puncture of the bladder "in the male (says Sir Astley) is not the operation which I perform, nor do I recommend it as a general practice." (*Lectures, &c.* vol. ii. p. 307.) In another place, he pronounces the puncture of the bladder, in the male to be scarcely ever necessary. (P. 315.) Being called many years ago to a case of retention of urine from a stricture, situated in the urethra behind the scrotum, he tried to pass different instruments, without success. "Reflecting upon the case (says he), it appeared to me to be exposing the patient to unnecessary pain and danger, if I punctured his distended bladder; as, when I directed him to make attempts to discharge his urine, the urethra swelled excessively behind the stricture, from the urine passing as far as its seat. I therefore determined to make an incision into the urethra only." (p. 316.) This was opened behind the scrotum, and the urine readily discharged. The patient rapidly recovered. Sir Astley Cooper gives other instances of the success of this practice, which has also an advocate in Sir Charles Bell (see *Surg. Reports*, part v.); and I believe, in all the best surgeons of this country. Sir Astley introduces a female catheter through the wound to prevent extravasation; but he deems this not absolutely necessary. If any difficulty were experienced, he recommends a catheter or staff, to be passed to the stricture; and, under the guidance of its beak, an incision to be made, and extended an inch backward, in a line with the beak. "The state of the urethra in stricture (he adds) is very different from that which exists with fistula in perinæo: in the former case, it is large behind the obstruction; in the latter, it is contracted, and very difficult to find." (*Lectures, &c* vol. ii. p. 318.)

No doubt, a man who is exceedingly skilful in the use of the catheter, and knows how to practise, with science and judgment, all the other means for relieving the retention of urine, will not frequently find it necessary to have recourse to any operation. This is said to have been so much the case with the eminent Desault, that, in the course of ten years, he had occasion only once to puncture the bladder in the Hôtel Dieu, where diseases of the urethra are always numerous. (See *Œuvres Chir. de Desault, par Bichat*, t. ii. p. 316.) M. Roux is stated never to have met with a single instance, in which there was a necessity for puncturing the bladder. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. iii. p. 960.) When, however, this superior manual dexterity with the catheter is not the acquirement of the practitioner, the timely performance of paracentesis of the bladder, or at all events, the making of an outlet for the urine in some way or another, should not be neglected. It is gratifying to know, however, that, at the present day, the absolute necessity for puncturing the bladder is rendered less frequent, not only by the treatment of diseases of the urethra being better understood than formerly, but also by the very great perfection to which the construction of elastic gum catheters is brought, instruments, from which the most essential assistance may frequently be derived. Strictures in the urethra, and enlargement of the prostate gland, are the two cases most frequently producing a retention of urine; and, in both of them, Sir Astley Cooper considers the operation of puncturing the bladder (with very few exceptions) entirely unnecessary; an opinion with which my own observations lead me fully to concur. In cases of enlarged prostate gland, a skilful surgeon will almost always succeed in introducing a catheter of proper shape and length; and in examples of retention from stricture, when relief cannot be afforded by ordinary means, the best plan, generally, is not to puncture the bladder, but to make a small opening in the part of the urethra between the stricture and the prostate gland; a part which is most commonly much dilated.

1. Puncture through the Perineum.

This operation was first performed by M. Tolet, the author of a treatise, entitled *Traité de Lithotomie, ou de l'Extraction de la Pierre hors de la Vessie, troisième édition*, Paris, 1681. According to Sabatier, it was customary in the time of Dionis to make the opening with a narrow-pointed scalpel, about four or five inches long, which was plunged into the bladder, at the place where the incision in the apparatus major terminated. (See Lithotomy.) The escape of the urine indicated when the surgeon had reached the bladder. A straight probe was conducted along the knife, and then a cannula was passed over the probe into the bladder, where it was allowed to remain as long as necessary, care being taken to fix it by means of tapes, put through the rings at the broad part of the instrument. The opening was then closed with a linen tent. Dionis first suggested the method of opening the bladder on one side of the perineum, at the part where Frère Jacquess used to perform lithotomy, and he conceived that this mode had advantages, because neither the urethra, nor the neck of the bladder was injured. A narrow scalpel was first introduced, so as to make a passage for the probe, and along this the cannula was guided into the bladder. The idea of substituting for these unsuitable instruments a trocar originated in 1721, with Juncker (see *Conspectus Chirurgiæ*, tab. 97. p. 674.) unless the following passage be correct: "In the year 1717, or 1718, M. Peyronie showed in the King's garden a long trocar, which he had successfully employed in a similar puncture." (*Desault's Parisian Chir. Journ.* vol. ii. p. 267.)

The patient having been placed in the same position as for lithotomy, an assistant is to press with his left hand on the region of the bladder, above the pubes in order to propel that viscus as far downward into the lesser pelvis as possible, while, with his right hand, he supports the scrotum. The surgeon is then to introduce the trocar at the middle of a line, drawn from the tuberosity of the ischium to the raphe of the perineum, two lines more forward than the verge of the anus. The instrument is first to be pushed in a direction parallel to the axis of the body; and its point is afterwards to be turned a little inwards. Here, according to Bichat, there is no occasion to convey the cannula so far into the bladder, as is done when the operation is performed above the pubes. The portion of this viscus which is to be pierced, being incapable of changing its position, with regard to other parts in the perineum, if the cannula only project a few lines into its cavity, it will not be liable to slip out. It would be wrong, indeed, to carry it in further; for the pressure of its end against the posterior parietes of the bladder would do harm. Lastly, the canula is to be fixed in its place by means of the T bandage. (See *Œuvres Chir. de Desault*, t. iii. p. 320) As a silver cannula, when kept introduced too long, becomes covered with a thick incrustation rendering its extraction difficult and painful, care should be taken to withdraw it after five or six days, and replace it, as soon as it has been cleaned, or else substitute another for it, according as the circumstances of the case. When Dr. Ehrlich visited London, Mr. Chandler tapped the bladder through the perineum, and introduced a cannula, which, after remaining in the puncture three weeks was so thickly covered with an incrustation, that its extraction produced considerable laceration of the parts, and a great deal of inflammation followed by an urinary fistula. (See *Dict. des Sciences Méd.* t. ii. p. 205.)

The parts, divided in the puncture, are the skin, perineal fascia, a good deal of adipous and cellular substance, the levator ani muscle, and that portion of the lower part of the bladder which is situated on one side of its neck.

The puncture of the bladder from the perineum is now universally abandoned by British surgeons. "We may esteem it fortunate," says Desault, "if the trocar penetrates directly into the bladder, after piercing the fat and the muscles, situated between the tuberosity of the ischium and the anus; and, as this viscus is subject to much variation in its form, the surgeon will often be defeated, unless he be perfectly clear in his ideas respecting its situation and figure. This disappointment is not without example, and there is sufficient cause to deter a practitioner from performing this operation, independently of the danger of wounding with the trocar the vasa deferentia, vesiculæ seminales, ureter," &c. (*Parisian Chir. Journ.* vol. ii. p. 267.) Sabatier conceives that the operation would be more safe if the surgeon were to begin with making a deep incision in the perineum, as is practised in the lateral way of cutting for the stone, and if he were to desist from plunging the trocar into the bladder until he had assured himself of the situation of this viscus, and felt the fluctuation of the urine. (*Médecine Opératoire*, t. ii. p. 127.) Sir Astley Cooper, also directs an incision to be made in the perineum, as in lithotomy; the bulb of the penis to be pushed towards the patient's right side; the knife then carried within the branch of the ischium till it reaches the prostate gland, which is likewise to be pushed towards the patient's right side; and, lastly, the instrument to be passed obliquely upwards into the bladder, the operator's finger resting on the prostate gland. (*Lectures, &c.* vol. ii. p. 314.)

2. Puncture above the Pubes.

The method of tapping the bladder above the pubes was suggested by the possibility of extracting calculi from that viscus, by what is usually denominated the high operation. The first performers of the puncture above the pubes are said to have employed a straight trochar. The consequence was that when such a trocar was too long, its cannula hurt the opposite parietes of the bladder, so as to occasion inflammation and a slough, on the separation of which the urine was liable to insinuate itself either into the abdomen, or rectum, as happened in a case mentioned by Mr. Sharp, where no more urine was discharged through the cannula, and the patient died of a sort of diarrhœa. When the trocar is short, the bladder, on subsiding and contracting itself, gradually quits the cannula, which becomes useless, and a necessity for making another puncture may be produced. Whatever pains may be taken to direct the trocar obliquely downwards and backwards, so that the cannula may be, in some degree, parallel to the axis of the bladder, one or the other of these accidents cannot always be prevented.

Their prevention, however, may be effected by merely employing, instead of a straight trocar, a curved one, which will naturally take a suitable direction. This improvement was soon embraced by Frère Côme.

To this way of operating, Mr. Sharp was partial, and Mr. Abernethy has recommended it, under certain circumstances. It is an operation generally of no difficulty to the surgeon, and of little pain to the patient, the violence done to the bladder being at a distance from the parts affected. It is equally applicable whether the disorder be in the urethra or prostate gland; and when there are strictures, the use of bougies may be continued, while the cannula remains in the bladder. (*Critical Inquiry*, p. 125. ed. 4.)

Some surgeons recommend making an incision, about two inches long, through the linea alba, a little way above the pubes, and then introducing a trocar into the bladder. Others deem this preliminary incision quite useless, asserting, that the operation may be performed with equal safety, and less pain to the patient, by puncturing at once the skin, the linea alba, and the bladder. If the person were very corpulent, an incision might be proper; but, in ordinary cases, it is not necessary. When the trocar has been introduced, the stilette must be withdrawn, and the cannula kept in its position by a riband, passed through two little rings, with which it should be constructed, and fastened round the body. The orifice of the cannula should be stopped up with a little plug, so as to keep the urine from dribbling away involuntarily, and taken out as often as may be necessary, (*Encyclopédie Méthodique; Part Chirurg. art. Paracentese de la Vessie.*)

The trocar should be introduced in a direction obliquely downward and backward; for, as this corresponds with the axis of the bladder, the instrument will be less likely to injure the opposite side of that organ.

Nearly all writers advise the puncture to be made an inch, or an inch and a half, above the pubes. The reasons for so doing are the following: — "If the puncture be made close to the os pubis, the bladder in that part, often rising with an almost perpendicular slope, leaves a chasm between it and the abdominal muscles, or, to speak more strictly, a certain depth of membrana cellularis only, so that, if the trocar penetrate but a little way, it possibly may not enter into the bladder. If it penetrates considerably, it may pass through the bladder into the rectum, or if not in the operation itself, some days afterwards, when by the course of the illness and confinement the patient is more wasted; for, the abdominal muscles, shrinking and falling in, occasion the extremity of the cannula to press against the lower part of the bladder, and in a small time, to make a passage into the rectum." (*Sharp*, in *Critical Inquiry*, p. 127.) Though the reasons here adduced seem formidable, does not the danger of injuring the peritoneum form an objection to plunging in a trocar at the above distance from the pubes? Certain it is, peritonitis would be more apt to be induced by such practice, than by introducing the instrument nearer to the pubes. Richerand decidedly condemns the plan, principally because the higher the puncture is made, the more apt the bladder will be to quit the cannula, on the urine being discharged. (See *Nosog. Chir.* t. iii. p. 472. ed. 2.) In Desault's works, by Bichat, the puncture is advised to be made immediately above the pubes (t. iii. p. 318.) Some of Sharp's objections are removed, by taking care to pass the trocar into the bladder in the axis of this viscus, and employing one which is somewhat curved, as Hunter, Frère Côme, Sabatier, &c. have advised. Sharp confirms the danger of using too long a cannula, by mentioning an accident, which occurred in his own practice. Though he introduced the instrument more than an inch and a half above the os pubis; yet, having pushed it full two inches and a half below the surface of the skin, its extremity in six or seven days insinuated itself into the rectum. (*Critical Inquiry*, p. 127.) The instrument should be more or less long, according as the patient is fat, or otherwise; but, the ordinary length should be about four inches and a half. The curvature should be uniform, and form the segment of a circle, about eight inches in diameter. (*Œuvres Chir. de Desault par Bichat*, t. iii. p. 317.)

A catheter left in the bladder longer than ten days, may gather such an incrustation from the urine, as to render the extraction of it difficult. Surgeons, therefore, should never leave the cannula in the bladder quite a fortnight; or, if it must be kept introduced so long, Sharp advises a second one to be introduced, made with an end like that of a catheter. (*Critical Inquiry*, p. 129.)

Mursinna, however, has reported one example, in which a cannula was kept in for a long time without inconvenience: (*Hecker*, *Annales der Ges. Médicin.* 1810., Jul. p. 39.) I have seen one such case myself; and another example of the same kind is mentioned by Sir Astley Cooper (*Lectures*, vol. ii. p. 310.)

Mr. Abernethy recommended making an incision between the pyramidales muscles, passing the finger along the upper part of the symphysis pubis, so as to touch the distended bladder, and introducing a common trocar, of the middle size, in a direction obliquely downwards. On withdrawing the stilette, he directs a middle-sized elastic catheter to be passed through the cannula into the bladder. The cannula is withdrawn, and the catheter left in till the urine passes through the urethra. After a week, the instrument is taken out, and a new one introduced. (*Surgical Obs.* 1804.) It might be objected to this plan of employing a gum catheter, that, as it is smaller than the wound, the urine is not kept from passing between the instrument, and parts, into which it is introduced, as well as through the tube itself. This happened in Mr. Abernethy's case; and, though no urine in this instance got into the cellular membrane, it might sometimes do so, because it is not till after inflammation has taken place that the cavities of the cellular tissue are closed with coagulating lymph. In one instance where I performed this operation, and substituted an elastic catheter for the silver cannula, on the second day it was suspected that some small quantity of urine had got between the catheter and side of the wound; for, in the *post mortem* examination, pus was found in the course of the puncture, and inflammation of the neighbouring parts. After two days, however, the cannula of the trocar may be safely withdrawn, and the elastic gum catheter employed.

The following is one of Sir E. Home's conclusions: — "When the puncture is made above the pubes, the cannula which encloses the trocar is not to be removed, till the surrounding parts have been consolidated by inflammation, so as to prevent the urine, in its passage out, from insinuating itself into the neighbouring parts; for wherever the urine lodges, mortification takes place. Any advantage, therefore, which may arise from a more flexible instrument remaining in the bladder, is more than counterbalanced by its not filling completely the aperture through the coats of the bladder, and allowing the urine to escape into the cellular membrane." (*Trans. of a Soc. for Med. and Chir. Knowledge*, vol. ii.)

In six or eight days, when the track of the cannula is surrounded by the adhesive inflammation, and a kind of pseudo-membrane, some surgeons withdraw the tube entirely, believing that, after this space of time, there is no risk of effusion of urine. (See *Manec Man. de Méd. Opér.* p. 684.) Whether this should be done, or not, seems to me to depend materially upon the circumstance whether the urine has resumed its natural course or not. In the latter case, I would not discontinue the employment of the tube.

Some surgeons prefer this method to tapping the bladder from the rectum. It is easy. The little thickness of the parts which are wounded, renders it quick and triflingly painful. With moderate care, it is almost impossible to miss the bladder, except it be exceedingly contracted, which, I believe, was the case in an instance where I saw the late Mr. Abernethy fail to make the trocar reach that organ. If the trocar be directed too much downwards, it may also not enter the bladder, but pass between it and the pubes. It should, therefore, be pushed in a line towards the upper part of the hollow of the sacrum, and not in one leading to the point of the coccyx. There is no risk of piercing the cavity of the abdomen. Anatomy proves, that here the bladder is in immediate contact with the recti muscles, or rather the fascia transversalis, and that when it is distended with urine, it pushes the peritoneum upwards and backwards, under which it enlarges, and thus makes the point of the trocar become more and more distant from the peritoneum. No nerves nor vessels of importance are exposed to injury. No difficulty is experienced in fixing the cannula, the presence of which does not hinder the patient from sitting, standing up, or even walking about in his chamber. (See *Œuvres Chir. de Desault*, t. iii. p.319-324.)

This operation (according to Sir Astley Cooper,) is easily performed, and not liable to the objections formerly made to it. To prevent the urine from passing through the cannula incessantly, a stopper is employed, and withdrawn as often as necessary. In the female, it is the only proper one in cases of retention of urine from retroversio uteri, and from an obliteration of the meatus urinarius by cancerous disease; for (says he) opening the bladder through the vagina, "would probably cause a fistulory orifice, by which the urine would constantly irritate the vagina." He adds, that, in the female, the operation above the pubes appears on every account preferable to all other methods. (See *Lectures*, vol. ii. p. 319.)

The following passage in a modern publication is decidedly a mistake: — "Whenever the bladder rises fairly an inch and a half above the pubes, it is in contact with the peritoneum, lining the wall of the abdomen, in addition to its own peritoneal covering. In other words, the shining surface of the peritoneal covering of the bladder is in contact with the same surface of the peritoneum lining the muscles of the abdomen; so that an instrument, to penetrate this part of the organ, must traverse the peritoneum twice." (*T. King, Lithotrity and Lithotomy compared, &c.* p. 31. 8vo. Lond. 1832.) About a year ago, I was called upon to tap the bladder above the pubes, in the North London Hospital, in a case of enlarged prostate gland, where the spiral course of the urethra through that body, and the existence of a perforation in it, frustrated the attempts to make the catheter pass by the natural route into the bladder. The patient died on the third or fourth day after the operation. The parts, which are preserved in the museum of University College, exhibit the track of the trocar, completely below the peritoneum, which has not been penetrated at all. After the puncture, above the pubes, the patient may easily lie on his side, so as to discharge all the urine contained in the bladder.

3. Puncture from the Rectum.

This method is not, like the puncture in the perineum, liable to the objection, that the wound is made in diseased or inflamed parts, which afterwards become gangrenous. Nor is it, like the puncture above the pubes, attended with a chance of the urine diffusing itself in the cellular tissue. It has also the advantage of emptying the bladder, completely. It is attended with little pain, since there is no skin nor muscles to be wounded, merely the coats of the bladder and rectum, at a point where these viscera lie in contact with each other.

We read in the *Phil. Trans.* for 1776, of a case of total retention of urine, from strictures, where the bladder was successfully punctured from the rectum. The plan was suggested to Mr. Hamilton, who did the operation, by his feeling the bladder exceedingly prominent in the rectum, when his finger was within the bowel. The patient was placed in the same position as that for lithotomy; a trocar was passed along the finger into the anus, and pushed into the lowest, and most projecting part of the swelling, in the direction of the axis of the bladder. A straight catheter was immediately introduced through the cannula, lest the bladder, by contracting, should quit the tube which was taken away, and, as soon as the water was discharged, the catheter was also removed. Notwithstanding the puncture, the bladder retained the urine as usual until a desire to make water occurred. Then the opening made by the instrument seemed to expand, and the water flowed in a full stream from the anus. The urine came away in this manner two days, after which it passed the natural way, with the aid of a bougie, which had been passed through the urethra into the bladder, and which was used till all the disease in this canal was cured.

The method was originally proposed in 1750, by M. Fleurant, surgeon to *La Charité*, at Lyons; and Pouteau, in 1760, published an account of it, and three cases in which Fleurant had operated. It was also the feel of the bladder, on the introduction of a finger *intra anum*, which led the latter surgeon to make the puncture in this situation. The urine was immediately discharged, and the cannula supported in its place with the T. bandage, until the natural passage had been rendered pervious again. But as the cannula was left in the rectum, it annoyed the patient when he went to stool, and the inconvenience was vastly increased by the continual dribbling of the urine from the mouth of the instrument. Hamilton avoided both these inconveniences, by withdrawing the cannula at first. In another instance, however, Fleurant left the cannula in the anus and bladder, thirty-nine days, without the least inconvenience.

In order to lessen the tenesmus, and other inconveniences attending the presence of the cannula, Fleurant suggested, that it would be better to employ a flexible tube, and some of the moderns approve the plan of passing a flexible catheter through the silver one into the bladder, and withdrawing the latter instrument.

In the first volume of the *Mem. of the Medical Society of London*, two cases are related, in which, after the bladder had been from the rectum, the cannula was immediately withdrawn, without any bad effect; and a similar fact is recorded in the *Medical Communications*, vol. i.

A curved trocar five inches in length, is the best for performing the operation, and was recommended by Pouteau. It should be introduced into the prominence made by the distended bladder a little beyond the prostate gland, exactly in the centre of the front of the rectum; but not imprudently far up the intestine, lest the cul de sac of the peritoneum be injured. For some useful cautions on this head, the profession are indebted to Mr. Carpue, who has adverted to the very low point, to which the portion of peritoneum reflected over the rectum descends. (*Hist. of the High Operation, &c.* p. 178. 8vo. Lond. 1819.)

The trocar should be introduced in the direction of the axis of the bladder, or nearly in an imaginary line drawn from the spot to be punctured to the middle point between the navel and the symphysis pubis.

The patient should be placed nearly in the same posture as that adopted in lithotomy; but the hands and feet need not be bound together, it being sufficient to let the assistants support the legs. The left forefinger, smeared with oil, is to be introduced up the rectum, where a portion of the distended bladder will be felt behind the prostate gland, and between the converging vasa deferentia. The vesiculæ seminales, which are on the outside of the vasa deferentia, are less exposed to injury. Behind the prostate gland, as Sir Astley Cooper correctly explains, there is a triangular space, which affords room for the instrument. In the fore part, it is bounded by the meeting of the vasa deferentia, which forms the apex of the triangle; the sides are formed by the vasa deferentia, which diverge as they pass from the prostate backwards; while the basis of the triangle is formed by the peritoneum, which is reflected from the posterior part of the bladder to the rectum. Taking advantage of this space of the bladder, which is not covered by the peritoneum, the trocar is introduced through it into the bladder, about three quarters of an inch behind the prostate gland. The instrument must not be introduced directly behind the prostate, as the vas deferens on one side or the other, would certainly be wounded. If the trocar be carried three quarters or half of an inch behind the prostate, the vasa deferentia will be safe. (*Lectures, &c.* vol. ii. p. 311.) Here the surgeon is to let the end of his finger continue, until, with his right hand, and under the guidance of the left forefinger, he has brought to the same point the extremity of the curved trocar, the concavity of which is to be kept forwards. Great care must also be taken not to let the stilette project out of the cannula too soon, that is to say, before the end of the tube has been placed exactly upon the spot, at which the puncture is to be made. The bladder having been emptied, the cannula is fixed with tapes, passed through the rings on the handle, and fastened in front and behind to a band applied round the body. It is to be further supported with a double T bandage. A stopper may be employed; or if the patient be on his side, the urine may be conducted from the tube into a pot or urinal, by attaching to the cannula a flexible catheter. When the patient has a motion, the T bandage is removed, and the cannula raised and supported with the hand.

It is not necessary to retain the cannula in the puncture, after the inflammation has consolidated the sides of the wound; for there is no danger of the aperture closing up, before another passage is made for the urine. Sir E. Home thinks, that, after about thirty-seven hours, the cannula may be taken out. (*Trans. of a Soc. for Med. and Chir. Knowledge*, vol. ii.) Indeed I am not acquainted with any fact, showing the ill effect of removing the cannula early; for, here the urine has only to pass through a mere opening, without any longitudinal extent, like what remains after the puncture above the pubes. The general safety and simplicity of tapping the bladder from the rectum, will always recommend this method. When, however, the rectum is diseased, or there is much inflammation about the neck of the bladder, or the prostate gland is considerably enlarged, this plan is not eligible.

The late experienced Mr. Hey is amongst the advocates for this operation; and as his opinion must have considerable influence, I shall quote the following passage from his valuable work, particularly as the observations confirm some other points, adverted to in the present article: — "It is sometimes impossible, from various causes, to make a catheter pass through the urethra. The puncture of the bladder then becomes necessary, if the retention of urine continues. This operation may be performed, either above the pubes, or through the rectum. I have seen it performed in both these methods; but give the preference to the latter. It is more easy to the surgeon; and less painful to the patient. Pouteau's curved trocar is a very convenient instrument, and may be used with safety for puncturing the bladder through the rectum; but the operator should cautiously avoid wounding an artery, which may be felt running towards the anus, where the bladder is most protuberant. The finger, which is introduced into the rectum to guide the trocar, may be conveniently placed a little on either side of this vessel. It is not always necessary to leave the cannula in the bladder, as the urine sometimes begins to flow through the penis, within a few hours after the bladder is emptied. Perhaps, this event may be the most frequent, when the introduction of the catheter has been prevented by a stricture in the urethra. If the wound becomes closed before the power of expelling the urine is regained, recourse must be had to a repetition of the operation, which gives very little trouble to the patient; neither is he much incommoded by suffering the cannula to remain two or three days in the bladder. This is sometimes necessary, and seldom improper." (*Hey's Pract. Obs. in Surgery*, p. 430, 431. ed. 2.)

The objections made to the puncture through the rectum are three: first, the annoying tenesmus sometimes produced by the presence of the cannula; secondly, the irritation and ulcerated state of the rectum occasionally resulting from the dribbling of the urine through it; and, thirdly, the possibility of a sinus being formed between this bowel and the bladder. (*A. Bonn, Bemerkungen ueber den Harnverhalt, &c.* Leipz. 1794.) Sir Astley Cooper knows of some cases, in which such inconveniences followed, and in particular, one instance, in which the patient died, of the subsequently diseased state of the rectum. Hence, the puncture of the bladder from the rectum is not a practice, on which he bestows any commendation.

In the foregoing columns, I have briefly adverted to the proposal of cutting into the urethra behind the obstruction, instead of puncturing the bladder. This plan was first adopted and recommended by Sir Astley Cooper; and it afterwards had an advocate in Sir Chas. Bell. Mr. Grainger, of Birmingham, a few years ago, also recommended cutting into the urethra, immediately in front of the prostate, and relieving the bladder by the introduction of a female catheter through the gland, or (if that could not be accomplished) by the division of its substance with a scalpel. (*Med. and Surg. Remarks, &c.* 8vo. Lond. 1815.) The operation of cutting into the membranous portion of the urethra, behind the stricture, seems to me one of the greatest improvements in modern surgery; for, as it is chiefly in a few cases of stricture that an artificial outlet for the urine is required, the new plan, which, as compared with a wound of the bladder, is a trifling injury, nearly obviates all necessity for puncturing the bladder in any way.

Women rarely stand in need of paracentesis of the bladder, an occasional impossibility of introducing the catheter from a retroversion of the womb, and an obliteration of the meatus urinarius by disease, being almost the only cases ever placing them in this condition. The only method, applicable to them, is the puncture above the pubes, with the exception of the plan of introducing the trocar directly from the vagina into the bladder; a practice which Sir Astley Cooper justly condemns, on account of its leading to the formation of an urinary fistula in the vagina, and a great deal of disease and irritation in that passage, from the contact of the urine.

Consult *Sharp*, On the Operations, chap. xv. and his Critical Inquiry. *Ambr. Bertrandi*, Trattato delle Operazioni di Chirurgia, accresciuto di note, &c. dai Chirurghi. *G. A. Penchienati e G. Brugnone*, 8vo. Torino, 1802. *Bertrandi* was an approver of the puncture from the rectum: so was *Le Blanc;* Operat. de Chir. t. i. Melanges de Chirurgie, *Pouteau*, Lyon, 1760, p. 500. L'Encyclopédie Méthodique, Partie Chirurgicale, art. Paracentèse de la Vessie. *Schmucker*, Chir. Wahrnehmungen, 2 th. No. 39: puncture from the rectum. *Sabatier*, Médecine Opératoire, t. ii. *Mursinna*, Journ. für die Chirurgie, &c. iv. p. 46. 67. Cases of Puncture from the rectum, and above the pubes. In illustration of the operation of puncturing the bladder, *Camper*'s plates are the best; see his Demonst. Anat. Pathol. lib. ii. In this work, the danger of letting the end of any long instrument, when introduced, press against the inside of the bladder, is proved by a case, in which that organ was perforated by the extremity of a catheter, p. 11. *Kloss*, Dis. de Paracentesi Vesicæ Urinariæ per intestinum rectum. Jen. 1791. *A. Bonn*, Anat. Chir. Bemerkungen über die Harnverhaltung, und den Blasenstich. Leip. 1794: prefers the puncture above the pubes. *J. Howship*, in Pract. Obs. on Diseases of the Urinary Organs, p. 214, 8vo. Lond. 1816, and in Treatise on Complaints affecting the Secretion and Excretion of the Urine, p. 412. Lond. 1823: thinks the operation from the rectum generally superior to the other methods. Sir *E. Home*, in Trans. for the Improvement of Med. and Chir. Knowledge, vol. ii. *Abernethy*'s Surgical Observations, 1804. *John Bell*'s Principles of Surgery, vol. ii. Œuvres Chir. de Desault par *Bichat*, t. iii. p. 315, &c. *W. Schmid*, Ueber die Krankheiten der Harnblase, &c. 8vo. Wien, 1806. *Richerand*, Nosogr. Chir. t. iii. edit. 4. *Hey*'s Practical Obs. in Surgery, p. 430. edit. 2. Parisian Chir. Journal, vol. ii. p. 156, and p. 265. *S. T. Sommering*, Ueber die schnell und langsam todlichen Krankheiten der Harnblase, &c. Frankfurt, 1809. The author is an advocate for the puncture above the pubes, in preference to that through the rectum, which he thinks right only in one case, viz. when the bladder is so contracted that it does not rise out of the lesser cavity of the pelvis, and the fluctuation of the urine can be felt in the rectum, but not above the pubes. In this opinion he is joined by *Langenbeck*. (Bibliothek, b. iii. p. 719.) *Callisen*, Systema Chirurgiæ Hodiernæ, t. ii. p. 277, &c. Chirurgische Versuche *von B. G. Schreger*, b. i. p. 211, &c. 8vo. Nurnberg, 1811; gives the preference to the puncture above the pubes. *Edward Grainger*, Med. and Surg. Remarks, &c. with Obs. on the different modes of opening the bladder in retention of urine, &c. 8vo. Lond. 1815. Dict. des Sciences Méd. art. *Ischurie*. 1818. Sir *C. Bell*, Surgical Obs. 8vo. part v. Lond. 1818. *C. Averill*, Short Treatise of Operative Surgery, p. 174, &c. Lond. 1823. Sir *A. Cooper*'s Lectures vol. ii. p. 306. Lond. 1825. *Malgaigne* Man, de Méd. Opératoire p. 680. *Alf. A L. M. Velpeau*, Nouv. Elémens. de Méd. Oper. t. iii. p. 960. 8vo. Paris, 1832.

BLADDER, TUMOUR EXTIRPATED FROM.

Mr. Warner has recorded a case, in which an excrescence, growing from the inside of a young woman's bladder, was successfully removed. The patient, on the 24th of June, 1747, strained herself in endeavouring to lift a great weight, and she was immediately seized with a pain in the small of her back, and a total retention of urine. In April, 1750, she applied to Mr. Warner, who found that she had never been able, from the moment of the accident, to void a drop of urine without the assistance of the catheter; that she was in continual pain, and had lately been much weakened, by having several times lost considerable quantities of blood, occasioned by the force made use of in introducing the instrument into the bladder.

Mr. Warner, upon examining the parts with his forefinger, introduced into the meatus urinarius, discovered a considerable tumour, which seemed to be of a fleshy substance, and took its rise from the lower part of the bladder, near its neck. When the patient strained to make water, and the bladder was full, the excrescence protruded a little way out of the meatus urinarius; but, upon ceasing to strain, it presently returned. A purgative having been given the day before the operation, and the rectum emptied by means of an emollient clyster, Mr. Warner directed the patient to strain, so as to make the swelling project. He then hindered it from returning into the bladder by passing a ligature through it, and endeavoured to draw it further out, which was found impracticable. Seeing this, Mr. Warner dilated the meatus urinarius on the right side, by cutting it upwards, about half way towards the neck of the bladder, when, by pulling the swelling forwards, he was enabled to tie its base, which was very broad. For three days a good deal of pain was felt in the abdomen. On the sixth day, the tumour dropped off. From the first day, the urine came away, without assistance, and the patient perfectly recovered. The tumour resembled a turkey's egg in shape and size. (*Warner's Cases in Surgery*, edit. 4. p. 303.)

I lately placed in the Museum of University College, a scirrhous tumour, which I found in the bladder of an elderly man, whose thigh-bone broke as he turned himself in bed, in consequence of being weakened by the pressure of a cancerous tumour upon it. (See *Med. Chir. Trans.* vol. xvii. p. 51.)

For an account of other tumours of the bladder, I refer to J. Howship *On Complaints affecting the Secretion and Excretion of Urine*, 8vo. Lond. 1823.

BLADDER, HERNIA OF. See HERNIA.

Besides this case, the bladder in females is liable to prolapsus and inversion, through the meatus urinarius.

BLADDER, HYDATIDS VOIDED FROM.

This case is exceedingly rare. In one example, under Dr. Duncan, the hydatids discharged from the urethra were formed in the kidney. The symptoms were frequent desire to make water, and sometimes difficulty in making the evacuation, and pain about the hip, perineum, and glans penis. The pain in the perineum was generally felt six or seven hours before each hydatid was expelled. The expulsion of the hydatids was promoted by exhibiting twelve minims of diluted muriatic acid thrice a day. The hydatids voided were of a globular shape, and of the genus acephalo-cyst, and varied in size from that of a pea to that of a pigeon's egg. Probably they had enlarged after their descent into the bladder. (See *Liverpool Med. Journ.* for July, 1834.)

The following curious account of the post mortem appearances in an instance of this kind is given by Dr. Tyson:—"Therein, upon operation (says Dr. Tyson), we discovered a very strange sort of cystes, or bags, of the exact figure of eggs, of several dimensions, some larger than goose eggs, others as big as hen eggs, to the number of twelve in all; and about eight of them whole, and replete with limpid serum; all of them loose and free, without the least adhesion, either to one another, or the coat of the bladder. Nor could we imagine that this miserable patient could possibly make any water, but what happened upon the breach of some of these watery tumours, when the bladder was crowded beyond its dimensions. The ureters were of the largeness of the small guts in children, so that they could easily admit two fingers into their cavity. One of the vesiculæ being opened, had a large cluster of small ova, as big as grapes, all replete with liquor. All the rest contained nothing but serum." (*Tyson, in Philos. Trans.* 1687.)

Bladder, Insects discharged from.

The instances in which worms are stated to have been discharged from the bladder are numerous. Many are referred to in *Voigtel's Handbuch der Pathlogischen Anatomie*, b. iii. p. 337—342. An interesting example is recorded by Mr. Lawrence. (See *Med. Chir. Trans.* v. ii. p. 382, &c.)

About two years ago, I received from Mr. Law, of Penrith, Cumberland, many specimens of substances voided from a young woman's bladder, supposed by him to be portions of tæniæ. But, on submitting them to the examination of Mr. Richard Owen, at the College of Surgeons, he ascertained, perfectly to his own satisfaction, that the substances were only pieces of the intestines of pigeons, or other small birds, cut and prepared so as to bear some resemblance to tæniæ; and, consequently, that the woman is guilty of some trick or imposture, from monomania or other inexplicable cause. Mr. Law seems convinced, however, that the case is different from the view of it taken by Mr. Owen.

Bladder, Deficiency of.

Numerous examples in which this deviation from the natural structure has occurred, are recorded. The publications, however, which contain the most ample information on the subject, are, a Gottingen inaugural dissertation, entitled, "*De Vesicæ Urinariæ Prolapsu Nativo,*" by Dr. Roose, late professor in Brunswick, and a paper entitled, *An attempt towards a systematic account of the appearances connected with that malconformation of the Urinary Organs, in which the ureters, instead of terminating in a perfect Bladder, open externally on the surface of the Abdomen, by A. Duncan, jun. in Edin. Med. and Surg. Journal*, vol. i. In this last may be seen references to the most noted cases on record, both male and female. (See also *Handbuch der Pathologischen Anatomie von J. F. Meckel*, b. i. p. 650. 8vo. Leip. 1812.

Bladder, Rupture of the.

Many examples of this accident, occasioned by blows, or sudden violent pressure on the hypogastric region, and followed by fatal extravasation of urine, are upon record. So fatal is the occurrence, that Dr. Harrison is not aware of any instance, the particulars of which are published, having had a favourable termination. (See *Dublin Journ. of Med. Science*, vol. ix. p. 350.) The urinary bladder, in its empty and contracted state, as he correctly observes, lies so deeply in the male pelvis, as to be almost perfectly secured against any injury or accident, except that of a gun-shot wound, or a surgical operation. When, however, it becomes distended with urine, it rises up above the pubes, presses forward against the abdominal parieties, and is in a position much exposed to external injury. In this state, also, its coats are tense, expanded, and thin; conditions in which their tissue is more easily ruptured. Excluding from present consideration penetrating wounds and lacerations by spiculæ of fractures of the os pubes, the bladder is generally burst by violence, applied directly to the hypogastric region, as by a blow, or fall on this part, or the heavy pressure of a cart, or carriage wheel. In the museum of University College, are two specimens of ruptured bladder; in one the accident was occasioned in the following manner:—a man who had been drinking, and whose bladder was very full, went out of the house where his party was; but, it being dark, he struck the hypogastric region against a post, which he did not see. The consequence was the rupture of the bladder. The other specimen was taken from a fine young man, a patient of my own; the injury having occurred while the bladder was very full of urine, as he was wrestling with another person, whose knee in the fall made violent pressure on the abdomen, just above the pubes. Also the accident has sometimes been caused by a general concussion of the whole frame, such as a fall from a height, without any direct force acting on the vesical region itself. (See *Cusack's case in Dublin Hos. Rep.* vol. ii.) Again, the bladder may be ruptured by violent exertion, and repeated straining to empty it when over distended, in consequence of some obstruction to the flow of urine, or during the violent efforts of parturition. Lastly, it sometimes gives way from gangrene, when it has been long in a state of forced distension, or when, being in a state of plenitude, it is subjected to the long-continued pressure of the uterus during a protracted labour, or, in the earlier periods of utero-gestation, to the pressure on it caused by a retroversion of the womb, as exemplified in the cases recorded by Dr. William Hunter. (*Med. Obs. and Inq.* vol. iv. and v. Lond. 1771.; *Harrison, in Dublin Journ. of Med. Science*, vol. ix. p. 352.) In retention of urine, a rupture of the bladder from straining to empty it, is not a common event. One instance of it is mentioned by Sir Benjamin Brodie (*On Dis. of the Urinary Organs*, p. 12.) and another by Sir Everard Home. (*On Strictures*, vol. ii. p. 240.) But, as Dr. Harrison observes, it is doubtful, whether, in the latter case, the opening in the bladder was the effect of a sudden laceration, caused by muscular exertion, or of some preceding ulcerative, or gangrenous affection at the particular point, where the organ gave way. Generally, however, in retention of urine from stricture, when the urine becomes effused, it is not from a rupture of the bladder, but from that of the urethra behind the stricture, or in the immediate vicinity of the prostate gland. (*Harrison*, in *Dub. Jour. Méd. Science*, vol. ix. p. 352.)

It would appear from Dr. Harrison's investigations, that, when the distended bladder in the male has been ruptured by a fall or blow on the hypogastric region, or by a general concussion, that portion of it, which is covered by the peritoneum has very generally been the seat of rupture; the urine has consequently been effused in the abdomen, and the patient has been destroyed by peritonitis. (p. 354.)

The following is the explanation, offered by Dr.

Harrison of the fact, that, when the bladder is ruptured by a blow, or general concussion, the laceration is always found in that part of the organ, which is covered by the serous membrane. "The several tunics of the bladder allow of considerable distention, but least of all the peritonial: when, therefore, the bladder becomes fully distended, and is then subjected to any sudden, or violent compressing force, this tunic, which is then tense, and comparatively unyielding, will crack, while the subjacent tunics, which are connected to it will be torn along with it; whereas, in other situations, where cellular tissue occupies the place of the serous membrane, the coats of the bladder will yield considerably before they give way, or admit of laceration. (See *Dub. Jour. of Med. Science*, vol. ix. p. 371.) The bladder being pressed forcibly against the promontory of the sacrum in the male, seems to Dr. Harrison also to account for the rent being usually in the posterior region of that viscus. The rarity of the accident in females is ascribed by him to the greater size of the pelvis, the cavity of which is not so extensively occupied by the bladder when this is full of urine. Nor (says he) does the bladder incline so much backwards as in the male; on the contrary, it inclines more forwards, and enlarges more in the transverse direction; while the uterus and its lateral broad folds, may assist to break the shock of any external violence, applied to the hypogastric region, and so prevent the direct concussion of the bladder against the sacral promontory." (Vol. cit. p. 372.) The comparative unfrequency of a rupture of the bladder in children and boys, is referred by Dr. Harrison to their rarely suffering the bladder to become much distended with urine, and, in part, to the smaller size of the sacral promontory, and to the bladder, when full, lying in early life more in the abdomen.

With respect to the diagnosis of the kind of rupture of the bladder now under consideration, it is judiciously observed by Dr. Harrison, that as it is the effect of only two species of injury, the account of the accident will afford useful information. Thus, says he, every case on record has been the result, either of some force, directly applied to the abdomen, or of a general concussion of the whole frame. In this latter case, the injury is more likely to be overlooked, particularly if the individual has suffered in any other and more obvious manner: hence, after such accidents, the attention of the practitioner should be early directed to the urinary discharge, and, if there be any inability to pass the urine, and a desire to do so, the catheter should be introduced. When the rupture has been the effect of violence, directly applied to the hypogastric region, the symptoms are more obvious. The patient himself is often aware of the accident: he knew that his bladder was full at the time of the injury; perhaps, he felt it burst within him. Then the sensation of sinking and sickness, the pain in the abdomen, and the peculiar feeling about the præcordia, are all circumstances indicative of the rupture of some viscus. In addition to these symptoms, there will be a desire to make water, without the power of doing so; great pain in the belly and perineum, during the attempts; tension of the abdomen, the fulness being diffused, and not circumscribed, as in common retention of urine. When a catheter is introduced into the bladder, it meets with a peculiar resistance; and the urine flows through it, not in a stream, but as if it merely filled and overflowed the instrument slowly; at one time only in a few drops; at another, in considerable quantity; "this difference depending on some alteration in the direction of the instrument, or, in the degree of pressure, with which it is pushed against the bladder, whereby the edges of the rupture must be separated, and more or less of the abdominal and pelvic urine be discharged." (*Harrison*, in *Dub. Journ. of Med. Science*, vol. ix. p. 377.)

In one case, recorded by Mr. Cusack, only a few drops of urine could be drawn off with the catheter, on the day of the accident. On the next, no urine flowed at first; but, by changing the direction of the instrument, and on making pressure with the finger in ano, about three pints were discharged. On the third day, as all the symptoms continued unabated, the abdomen was punctured in the linea alba, midway between the umbilicus and the pubes; and a large quantity of clear urine, escaped, and, at the same time, it flowed freely from a catheter in the urethra. The relief was only temporary, the patient having died delirious on the eighth day. On dissection, marks of intense inflammation were noticed in the hypogastric region, where the intestines were glued together into one mass. At first no urine was seen; but, on breaking the adhesions and raising up the intestines, about a pint of it was sponged out from between the rectum and the bladder. "The pelvic portion of the peritoneum was completely coated with lymph; the bladder was contracted and empty; the rupture, about an inch in extent, was in its posterior part and right side, and in an oblique direction. (See *Cusack*, in *Dub. Hospital Reports*, vol. ii. p. 312.)

In the *post mortem* examination of a case under Dupuytren, traces of severe inflammation were observed in the hypogastric region. Adhesion existed between the abdominal parieties, and the bladder, and the sides of the latter and the adjacent viscera were all so agglutinited together, that a kind of pouch was formed, considerably advanced in organization, whereby the urine was circumscribed, and effusion to any further distance prevented. (See *Archives Gén.* June, 1834, p. 294.) In general, the bladder, though the seat of injury, is itself but little inflamed, except at the posterior portion of its serous coat. (*Harrison* in *Dub. Jour. of Med. Science*, vol. ix. p. 375.)

In the treatment, the principal indications are to withdraw, if possible, the effused fluid from the abdomen; to prevent, if possible, any return or increase of such effusion; and to resist and subdue that unavoidable and very fatal affection peritonitis. With this view, any accumulation of urine in the bladder should be prevented by the introduction of an elastic gum catheter, of full size with a long and large curve; and if, by changing its direction, or other manœuvres, its beak can be passed through the rent, or made to reach its vicinity so as to open it, a considerable quantity of urine may be drawn from the cavity of the peritoneum. Pressure with the finger in ano is also to be tried. (*Harrison*, vol. cit. p. 379.) In the case which I attended, a catheter of full size was kept continually introduced. In this way, we endeavour to lessen the exciting cause of the inflammation, which, however, is sure to follow the effusion of so irritating a fluid as the urine. Inflammation must therefore be resisted by local and general bleeding; calomel, opium, and mild saline purgatives given with the effervescing mixture. If the disease advance, and the pains in the abdomen become more intense, with swelling and fluctuation, ought the surgeon to perform paracentesis? As Dr. Harrison remarks, this has been done in two instances, but without success. "The urine which is effused is principally lodged in the pelvic cul-de-sac, and is more or less confined to that region, partly from its depending position, and partly from the adhesions, which we have reason to expect under proper and active treatment, may have been formed between the bladder and the adjacent viscera; at the upper orifice of the pelvis." This view leads Dr. Harrison to consider cutting a small opening through the rectum, into this cul-de-sac, the best and safest plan for the discharge of the irritating fluid. Here a new cavity has been formed, coated internally like an abscess; and the opening is not to be regarded as extending into the general cavity of the peritoneum. The operation might be done with a trocar, or a long curved bistoury, with a sheath, and a cutting edge only on its extremity. The patient being in the recumbent posture, with his knees drawn up and somewhat separated, the finger of the left hand might be passed up the rectum, as far as possible, and pressed against its fore part. The catheter in the bladder might also assist in guiding the finger to the cul-de-sac behind that organ. The cannula of a long curved trocar might next be passed along the finger, and, when its extremity had been placed against the fore-part of the rectum exactly in the median line, the stillette might be pushed through it, and the peritoneum opened. Dr. Harrison conceives that the quantity of effused fluid would protect the small intestines from reach of the instrument; and he says, that in the cases which he has examined, he did not find any of their convolutions in the pelvis. Supposing this operation were ever attempted, ought the cannula to be left in the part? or ought it to be withdrawn, and the catheter trusted to for the prompt discharge of the urine afterwards? The latter method is preferred by Dr. Harrison. (See *Boyer, Mal. Chir.* t. ix. p. 61; *C. Montague*, in *Med. Communications*, vol. ii. p. 284; *Cusack*, in *Dub. Hospital Reports*, vol. ii. p. 312; *Dupuytren, Archives Gén.* June, 1834, p. 294; *Johnstone*, in *Mem. of Med. Soc. of Lond.* vol. iii. p. 543; and, particularly *Dr. Harrison's Cases and Obs.* in *Dubl. Journal of Med. Science*, vol. ix. p. 349, to whom I am indebted for the chief information in the foregoing article.

Bladder, *Wounds of*. (See Gunshot Wounds.)

BLEEDING. By this operation is understood the taking away of blood for the relief of diseases. Bleeding is called *general*, when practised with a view of lessening the whole mass of circulating blood; *topical*, when performed in the vicinity of the disease, for the express purpose of lessening the quantity of blood in a particular part.

General Blood-letting is performed with a lancet, and is subdivided into two kinds; viz. the opening of a vein, termed *phlebotomy*, or *venesection;* and the opening of the temporal artery, or one of its branches, termed *arteriotomy*.

Topical Blood-letting is performed, either by means of a cupping-glass and scarificater, or leeches, or by dividing the visibly distended vessels with a lancet, as is frequently done in cases of ophthalmy. See Arteriotomy; *Cupping, Leeches, Scarification*, and *Venesection*.

BLEEDING. (See Arteries, Hemorrhage, Ligature Wounds.

BLENORRHAGIA, or *Blénorrhœa*, (from βλέννα, mucus, and ῥέω, to flow.) A discharge of mucus. Swediaur, who maintains, that gonorrhœa is attended with a mucous, and not a purulent, discharge, prefers the name of blenorrhagia for the disease. However, in treating of gonorrhœa, we shall find, that this last appellation is itself not altogether free from objections.

BLEPHAROPTOSIS (from βλέφαρον, the eyelid, and πτῶσις, a falling down.) Called also *ptosis*. An inability to raise the upper eyelid. (See Ptosis.)

BLINDNESS. An effect of many diseases of the eye. See Amaurosis; Cataract; Cornea Opacities of; Glaucoma; Hydrophthalmia; Leucoma; Opthalmy; Pterygium; Pupil, closure of; Staphyloma, &c.

BLISTERS. Applications, which, when put on the skin, raise the cuticle in the form of a vesicle, filled with a serous fluid. Various substances produce this effect; but the powder of cantharides is what is commonly employed. The blister-plaster is thus composed:—℞ *Cantharidis in pulv. subtilissemum tritæ* lbj. *Emplastri ceræ* lbiss. *Adipis præp.* lbss. The wax plaster and lard being melted, and allowed to become nearly cold, the powdered cantharides are added.

When it is not wished to maintain a discharge from the blistered part, it is sufficient to make a puncture in the cuticle to let out the fluid; but, when the case requires a secretion of pus to be kept up, the surgeon must remove the whole of the detached cuticle with a pair of scissars, and dress the excoriated surface in a particular manner. Practitioners used formerly to mix powder of cantharides with an ointment, and dress the part with this composition. But, such a dressing not unfrequently occasioned very painful affections of the bladder, a scalding sensation in making water, and most afflicting stranguries. An inflammation of the bladder, ending fatally, has been thus excited. The treatment of such complaints consists in removing every particle of cantharides from the blistered part, which is to be well fomented, and administering freely mucilaginous drinks. Camphor is now suspected to prove more hurtful than useful.

These objections to the employment of salves, containing cantharides, for dressing blistered surfaces, led to the use of mezereon, euphorbium, and other irritating substances, which, when incorporated with ointment, form very proper compositions for keeping blisters open, without the inconvenience of irritating the bladder.

The favourite application, however, for keeping open blisters, is the powder of savine, which was brought into notice by Mr. Crowther, in the first edition of his book on the White Swelling. He was led to the trial of different escharotic applications, in the form of ointment, in consequence of the minute attention, which caustic issues demand; and, among other things, he was induced to try powdered savine, from observing its effects in the removal of warts. Some of the powder was first mixed with white cerate, and applied as a dressing to the part that had been blistered; but the ointment ran off, leaving the powder dry upon the sore, and no effect was produced. Mr. Crowther next inspissated a decoction of savine, and mixed the extract with the ointment, which succeeded better, for it produced a great and permanent discharge. At last, after various trials, he was led to prefer a preparation analogous to the unguentum sambuci P. L. The following formula answers every desirable purpose: — ℞ *Sabinæ recentis contusæ* lbij. *Ceræ flavæ* lbj. *Adipis suillæ* lbiv. *Adipe et cera liquefacta, incoque sabinam et cola.*

The difference of this formula from that, which Mr. Crowther published in 1797, only consists in using a double proportion of the savine leaves. The ceratum sabinæ of Apothecaries' Hall, he says, is admirably made: the fresh savine is bruised with half the quantity of lard, which is submitted to the force of an iron press, and the whole is added to the remainder of the lard, which is boiled until the herb begins to crisp; the ointment is then strained off, and the proportion of wax ordered, being previously melted, is added. On the use of the savine cerate, immediately after the cuticle, raised by the blister, is removed, it should be observed, says Mr. Crowther, that experience has proved the advantage of using the application lowered by a half, or two thirds, of the unguentum ceræ. An attention to this direction will produce less irritation and more discharge, than if the savine cerate were used in its full strength. He found fomenting the part with flannel wrung out of warm water a more easy and preferable way of keeping the blistered surface clean, and fit for the impression of the ointment, than scraping the part, as has been directed by others. An occasional dressing of the unguentum resinæ flavæ he found very useful in rendering the sore free from an appearance of slough, or rather dense lymph, which is sometimes so firm in its texture as to be separated by the probe with as much readiness as the cuticle is detached after blistering. As the discharge diminishes, the strength of the savine dressing should be proportionally increased. The ceratum sabinæ must be used, in a stronger or weaker degree, in proportion to the excitement produced on the patient's skin. Some require a greater stimulus than others for the promotion of the discharge, and this can only be managed by the sensations which the irritation of the cerate occasions.

Mr. Crowther tried ointments, containing the flowers of the clematis recta, the capsicum, and the leaves of the digitalis purpurea. The two first produced no effect; the last was very stimulating. He also tried caustic potassa, mixed with spermaceti cerate, in the proportion of one drachm to an ounce: it proved very stimulating, but produced no discharge. One grain of the oxymuriate of mercury, blended with two ounces of the above cerate, proved so intolerably painful, that, at the end of two hours, it became necessary to remove the dressing; and the patient was attacked with a severe ptyalism. (*Practical Obs. on the White Swelling, &c.* 2d ed. 1808.)

Instead of keeping a blister open, it is frequently a judicious plan to renew the application of the emplastrum cantharidis, after healing up the vesication first produced, and to continue, in this manner, a succession of blisters, at short intervals, as long as the circumstances of the case may demand. Where the skin is peculiarly irritable, and, particularly, in young children, where the emplastrum cantharidis sometimes acts so violently as to produce sloughing, or, in any cases, where the plaster produces strangury and irritation of the urinary organs, I am informed that the inconvenience may be avoided, and the cuticle raised very well, if a piece of silk paper be interposed between the plaster and the integuments. Dr. A. T. Thomson recommends for the same purpose a piece of thin gauze, wet with vinegar, and applied smoothly and closely over the plaster. (*Dispensatory*, p. 717. ed. ii.) For infants, a proportion of opium has sometimes been added to the plaster, in order to render its action less violent; a proposal made, I believe, by the late Mr. Chevalier. Others recommend the plan of not letting the blister continue so long applied to children as to other patients.

In the North London Hospital, the nitrate of silver is often used for making blisters, as particularly recommended by Mr. Higginbottom. It causes less irritation, and its effects are more prompt, than those of cantharides. It may also be used in persons, in whom cantharides produce strangury. It excites a copious discharge, without heat or pain after the first few hours, and the vesicated part heals about the fifth day, no ulceration having been occasioned. (See *Higginbottom on Nitrate of Silver*, p. 161.) By means of the application of nitrated silver, repeated every six or eight days, and of perfect quietude of the part, secured by means of a splint and bandage, many a diseased joint has been cured in the North London Hospital.

"In applying blisters to infants," says Dr. Cumming, "we must take particular care not to allow them to remain on for more than three or four hours. When a blister is applied for a longer period, excessive general irritation is apt to be induced; and such is the delicacy of the infant's skin, that the blistered parts not unfrequently become gangrenous. Under such circumstances, the death of the child has been sometimes the consequence. Though vesications may not have formed, at the time when the blister is removed, they generally take place after the application of the dressing. In some habits, the blistered surface takes on an unhealthy action, and runs into eating and irritable ulcers, which are long in healing. In such cases, I have found an emollient poultice, when the inflammation is considerable, and afterwards the black and yellow washes, the most useful applications. In infants of an irritable habit, it will sometimes be advisable to dilute the blistering plaster with an equal quantity of the emplastrum ceræ." (*Dr. Cumming in Trans. of Assoc. of Coll. of Physicians, Ireland*, vol. v. p. 55.) — See *Paris's Pharmacologia*, vol. ii. p. 186. ed. 5. *A. T. Thomson's Dispensatory, and Elements of Mat. Med.* ed. 2. *John Higginbottom on the Use of Nitrate of Silver*, p. 161. ed. 2. 8vo. 1829. *Mayo's Outlines of Human Pathology*, ch. i.

BOIL. (See Furunculus.)

BONES, EXCISION OF. This operation is sometimes applicable to the articular portions of bones, but still more frequently to other parts of them. The circumstances under which it is practised for the removal of diseased, or very severely injured joints, and the plans then to be adopted, will be hereafter considered, (See Joints, Excision of.) Neither shall I dwell at present upon the removal of the projecting ends of broken or dislocated bones; nor upon sawing off the extremities of old ununited fractures; subjects noticed in the account of *Dislocation* and *Fracture*. In the articles

AMPUTATION and GUNSHOT WOUNDS. I have called the reader's attention to the praiseworthy method of cutting down to, and removing, all loose splinters of the os brachii, and even the sharp end of that bone itself, from certain gunshot injuries of the shoulder, so as frequently to obviate the necessity for amputating the limb. The cases demanding the removal of portions of the skull, and the manner of accomplishing it, will be described under the head TREPHINE. Towards the conclusion of the observations upon AMPUTATION, some account has already been given of the *excision of certain bones of the hand and foot.* It is difficult, as M. Malgaigne observes, to lay down any precise directions for the *excision of the bones of the tarsus.* The following plan was adopted by Moreau, the father, for an extensive caries:—Over the cuboid bone, there was one ulcer an inch in diameter; and another between the third and fourth metatarsal bones, resulting from an incision made a few days previously for the discharge of an abscess. A probe penetrated into the cuboid bone. An incision was made along the outer side of the foot, and extended across the ulcer, from the posterior third of the fifth metacarpal bone to above the anterior tuberosity of the os calcis; and, as the incision already made for the abscess could now be made serviceable, this and the other incision were conjoined by a transverse one, and the square flaps reflected. The diseased bones were thus brought into view, and it was necessary to remove the cuboid, the third cuneiform, the posterior end of the fourth metatarsal bone, the inner side of the extremity of the fifth, and the articular surface, by which the os calcis is united to the cuboid bone. The tendon of the peronæus longus was preserved. The flaps were then laid down, and united with two sutures. The patient, who was young, got completely well. The vacancies, occasioned by the extrication of the bones, were filled up by a substance which afterwards ossified. In the end, the patient was able to walk well; the foot having assumed its natural shape and motions. (See *Malgaigne, Man. de Méd. Opér.* p. 243.) The operation of removing the metacarpal bone of the thumb, or the metatarsal bone of the great toe, is not deemed by Mr. Liston an advisable proceeding; because the rest of the thumb or toe is left without support, and is useless. He has seen cases treated in this way; but the result was unsatisfactory. However, Monro removed *the whole of the first metatarsal bone* on account of caries, and M. Barbier did the same thing at the Val de Grâce after a dislocation of the bone; and, in each case, the result was in every respect successful. (See *Malgaigne, Op.* cit. p. 243.) The *extraction of the metacarpal bone of the thumb* has been performed with success by M. Roux and M. Blandin. The thumb was at first shortened and useless; but gradually became capable of executing all its natural movements. (See *Malgaigne, Man. de Méd. Opér.* p. 232.) An incision is to be made along the radial edge of the bone, and to extend about half an inch beyond each of its articulations. Then the integuments and extensor tendon are to be detached from its dorsal, and afterwards the muscles from its palmar surface. While an assistant holds aside the lips of the wound, the surgeon opens the outer side of the carpal joint with the point of the knife, cuts through the tendon of the long abductor, which is inserted into the metacarpal bone, and then carries the knife completely through the joint. He now tries to dislocate the bone outwards, and to pass the knife along its inner side, so as to effect its total detachment from the muscles. Lastly, the articulation with the first phalanx is opened by cutting in succession the internal and external lateral, and the anterior, ligaments. The radial artery may be avoided; but, were it wounded, the application of a ligature to it would be attended with no difficulty. The wound is to be brought together, and the thumb supported in its natural position with soft pads placed in the palm. (See *Malgaigne, Op.* cit.) *Excision of the anterior portion of the first metatarsal bone,* seems to M. Blandin advantageous, because, when the rest of it can be saved, the foot remains with a more solid support. A flap is formed at the inner side of the bone, with the base backward. The bone is exposed to the point where it is intended to divide it; sawn perpendicularly to its axis; then detached from its connections, from behind forwards; and finally disarticulated from the phalanx. With respect to the phalanges of the other four toes, amputation is commonly preferred to excision of them; and so it is to excision of the heads of their metatarsal bones. (*Malgaigne, Op.* cit. p. 242.) Although, the *excision of the metacarpal bone of the index* and *little fingers* may easily be performed by cutting along the outer margin of it, M. Malgaigne is probably correct in stating, that such an operation, in consequence of the subsequent shortening of the finger, would leave after it as much deformity as amputation would produce, and even greater weakness of the hand. This observation is not applicable, however, to the *excision of the metacarpal bones of the middle and ring fingers,* which will still retain their connection with the contiguous ones, and the strength of the hand be preserved. An incision is made along the dorsal aspect of the bone, by the side of the extensor tendon, which should not on any account be divided, and the disarticulation is to be begun at the knuckle. (See *Malgaigne, Man. de Méd. Opér.* p. 233.) The removal of dead, or softened and carious, portions of the carpal and tarsal bones, Mr. Liston admits, is sometimes successful; but, operative interference with these, or with more extensive and formidable articulations, is not advisable, unless the soft parts be not largely involved, and the general health tolerably good. If the ligaments, bursæ, and cellular tissue are much affected, Mr. Liston considers the chance of the discharge ceasing, and of the return of health, entirely hopeless. Amputation above the diseased parts will still be indispensable; and, in consequence of the more reduced and deranged state of the constitution, this second operation is less likely to answer than if it had been undertaken earlier. (See *Liston's Elem. part* iii. p. 398.) It is right to mention, however, that after necrosis of the first phalanx of the thumb, and the extraction of the fragments, M. Velpeau has known the part regain its motion. If an incision were necessary for the removal of this phalanx, it should be made along the radial side of the thumb, and the metacarpal articulation, which is the looser one, being opened first, the phalanx should then be luxated outwards, and dissected out. (See *Malgaigne, Man. de Méd. Opér.* p. 231.) In a few cases, Mr. Liston has removed several of the *tarsal and carpal bones;* as practised by Mr. Dunn of Scarborough (see

Amputation), in others, one, or a portion of one, with success. In one instance, the greater part of the *astragalus was taken away along with the ends of the tibia and fibula.* There remained a large opening across the joint, through which a seton was passed to promote the gradual and piecemeal discharge of the remaining portions of diseased bone. The articulation could be seen through. The seton was gradually diminished, and the aperture closed. The foot was preserved, and the leg was somewhat shortened; but the limb proved extremely useful, though the ankle retained little power of motion. Mr. Liston, as well as many other surgeons, has also trephined the *os calcis,* and *removed* large portions of it. He has likewise taken away the *cuboid bone, along with the bone of the metatarsal bone or bones,* in connection with it. In some of these cases an excellent cure followed; in others, amputation of the foot was afterwards necessary. (Vol. cit. p. 400.) Examples of the *removal of extensive portions* of the *os calcis* are reported by Hey, Moreau, and M. Roux. In the North London Hospital, there was a young woman, in 1835, from the outer part of whose os calcis Mr. Liston removed a considerable piece with a trephine. The case was a scrofulous caries. Some amendment followed; but the caries penetrated too far to admit of complete removal in this manner. A fine specimen of the same thing was lately put into my hands by Mr. Morton, of University College, the part having been finally amputated in the Newcastle Hospital. In one case, where the *scaphoid bone* of the carpus was dislocated by an injury, occasioned by machinery, Sir Astley Cooper successfully *removed* that bone. The rule proposed by him for any analogous case, is to take away one, or even two, of the carpal bones, if displaced; but, if the mischief is greater, to amputate.

I am not disposed to bestow much commendation on such an operation as the *excision of the ribs,* notwithstanding the high and respectable authorities which may be quoted in sanction of it, with the exception of its performance in cases where a sequestrum is nearly or entirely loose. The most remarkable excision of the ribs yet recorded is that performed by Mr. Richerand in 1818, on a medical officer, who was afflicted with cancer of the thorax. The middle portion of four ribs was removed to the extent of several inches. It was also necessary to extirpate the contiguous part of the pleura, which was very much thickened, and transformed into a cancerous substance. Thus, the pulsations of the heart, within the pericardium, were brought completely into view. The case afterwards went on favourably for a time; but in the end proved fatal by a return of the cancerous disease. I scarcely need advise British surgeons not to attempt any similar operation, where the disease of a rib, or indeed, of any other bone, is the effect of a primary cancerous affection of the soft parts. Such an experiment must inevitably terminate in the return of the original malignant disease, unless the patient's accelerated death happen not to leave sufficient time for this result. These observations are directed chiefly, however, to the particular case here specified; for, as the excision of portions of ribs has been performed by several eminent surgeons with success, I conclude that circumstances may occur in which the plan is justifiable. Not to lay any stress upon the instances of the practice in ancient times by Galen, Aymond, Sediller, Lecat, Ferrand, &c., it has been twice resorted to subsequently to Richerand's operation, and with success, by Attadini in Italy; also in the Hospitals Beaujou and La Charité at Paris; and by Dr. Mott, of New York. The operation consists in extending the incision through the soft parts beyond the extent of the diseased portion of the rib, both in front and behind, and then, after detaching the bone from the pleura at the point where it intended to divide it first, it may be sawn through with one of Hey's saws, or, what will be more convenient, divide with a pair of cutting pliers. The divided end of the bone should then be inclined outwards, and separated from its connections, so as to facilitate the safe division of it beyond the opposite extremity of the disease. A principal thing in the operation is to avoid injury of the pleura, as much as possible.

In 1825, the *excision of the radius* was accomplished with complete success by Dr. R. Butt, of Virginia; and in 1826, M. Velpeau had a case in which he was desirous of practising a similar operation, on account of disease entirely restricted to that bone; but the patient preferred amputation. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 565.) An incision is made along the outer and anterior part of the radius. The edges of the wound are to be held apart, and the muscles detached from its anterior and posterior surfaces; a little below its middle part, where it is most superficial; a chain saw is to be used, a director is now being introduced at the ulnar side of the bone, will serve to convey the chain saw behind it. In the place specified the bone is sawn through, and the two fragments carefully dissected out. If sufficient room were not obtained for the action of the saw by the longitudinal incision, a transverse one should also be made. (*Velpeau, ib.*) A strong pair of cutting forceps would divide the radius with less difficulty than a chain saw.

In an example of *necrosis of the outer third of the clavicle,* M. Velpeau removed the scapular portion of it. Two incisions, in a crucial form, and four inches long, were made, the flaps raised, the acromio-clavicular ligaments, and some parts of the origin of the deltoid and trapezius divided. The bone was then raised with a lever passed into the joint, and its detachment completed. M. Malgaigne conceives, that a better plan would be to make first an incision, parallel to the clavicle, but a few lines below it, and ending at the acromion, and then another shorter one at a right angle with this extremity of the first, so as to form a triangular flap. Instead of a chain saw, the clavicle may be very safely divided with one of Hey's saws, or a pair of cutting pliers, care being taken to pass a flexible copper spatula under the part.

The *sternal end of the clavicle* was removed many years ago by Mr. Davies, a surgeon of Bungay in Suffolk, on account of its being displaced backwards, and dangerously compressing the œsophagus; in consequence of the scapula being forced very much forwards by a deformity of the spine. (See Sir *Astley Cooper on Dislocations*) In this operation a piece of leather was placed under the bone to protect the subjacent parts from the saw. The interclavicular ligament was torn through, so as to free the sternal end. The patient was alive six years after the operation, and in good health.

The *whole clavicle* affected with osteo-sarcoma, was *removed* by Dr. Mott, of New York. The tumour was of the size of two fists, and reached upwards nearly to the hyoid bone, and angle of the jaw. A semilunar incision, with its convexity downwards, was made below the swelling, from one end of the bone to the other. Another incision was next made above the tumour from the acromion to the external margin of the internal jugular vein. The platysma, and a portion of the trapezius having been divided, a director was passed under the bone, near the acromion, and a division here effected with a chain saw. Not being yet able, however, to displace the tumour, Dr. Mott, with the aid of a director, extended the first incision, inwards; and, having applied two ligatures to the external jugular vein, and cut it through in the interspace, he next divided the clavicular portion of the sterno-mastoid muscle, and found it necessary also to tie and divide the internal jugular vein. The subclavian vein and thoracic duct were separated from the diseased parts with the handle of the scalpel. Lastly, the great pectoral muscle, the costo-clavicular ligament, and the subclavian muscle having been divided, the disarticulation of the sternal end of the clavicle was accomplished. The bleeding required forty ligatures for its suppression. In six weeks the wound was nearly healed, and the patient afterwards, with the aid of a mechanical substitute for the clavicle, retained the power of moving the limb, with but little impairment.

The *excision of the scapula*, to a greater or lesser extent, has been performed on several occasions. In one instance a considerable portion of the scapula was removed by M. Janson, on account of a tumour involving it. Two semi-elliptical incisions were made, so as to circumscribe the swelling; as much skin as possible was dissected up and saved: the tumour and bone were then detached from their connections in every direction, as low down as the fossa subscapularis. The attachments of the trapezius, supra and infra spinatus having been divided, and the portion of the bone above the spine ascertained to be sound, all the other diseased part was sawn off, and the shoulder joint left uninjured. One more incision was necessary to expose the whole of the tumour, and facilitate its excision. The wound was altogether six inches in breadth, and nine in length. The motion of the shoulder was preserved. A large tumour of the scapula was removed two or three years ago by Mr. Earle; but, as the disease returned, Mr. Skey removed it a second time, together with the greater part of the scapula. The disease, however, being of a malignant character, again returned and proved fatal. Several cases of this description have been lately met with in the hospitals of this metropolis. One was in the North London Hospital under Mr. Liston. I heard of another in the Westminster Hospital.

Excision of the whole of the fibula with the exception of its head, was performed by M. Scutin. The particulars are contained in M. Malgaigne's Manual. Many arteries required ligature, and amongst them the posterior tibial. The external popliteal nerve was also divided. As the tibia was slightly affected, the cautery was applied to it. In two months the wound was healed, and, in four, the patient could bear nearly as well on this leg as on the other.

In the articles Amputation and Gunshot Wounds, I have noticed the excision of the upper head of the humerus; and in that on Anchylosis, some account is given of Barton's *excision of the head and neck of the femur;* an operation, to which an allusion is made in the writings of C. White, of Manchester, and which has been performed by Sir Benjamin Brodie, Mr. Anthony White, and in Germany by Oppenheim. Sir Benjamin Brodie lately informed me that his patient died sometime afterwards of phthisis. I believe the case was one, in which it was suspected, that the disease was restricted to the head of the femur. My friend, Mr. Anthony White has favoured me with the following particulars of the case in which he performed the operation:—John West, a twin of delicate make, was born and resided in Westminster. When between four and five years old, he suffered from scrofulous inflammation in the left hip joint, which passed through the stages of elongation, dislocation, and subsequent retraction, and the femur was finally lodged in a very high position, on the dorsum of the ilium, "About three years subsequent to the commencement of the disease, and when he was about eight years old, I first saw him. He was much emaciated; several abscesses had formed during this period around and over the diseased structures, leaving many fistulous openings, through which the probe easily detected the surface of the displaced bone to be in a state of caries, and several small exfoliations had occurred, from the ilium, ischium, and os pubis, over which bones abscesses had formed. In the progress of the disease the knee of the affected limb had become inverted and firmly embedded on the lower and inner part of the opposite thigh, from which position it could not be removed, and every attempt to do so was accompanied with exquisite pain. All further attempts, therefore, were abandoned, and the limb left undisturbed. He had now lain nearly three years, on the opposite side, with the body considerably incurvated and without the power of changing his position. A profuse and debilitating discharge was constantly issuing from the numerous apertures leading to the carious surface of the displaced bone. In other respects, the health of the boy was tolerably good. Reflecting on this poor boy's case, it was evident, that, unless the knee could be removed from its firm lodgment on the opposite thigh, he must remain in the position above described during the remainder of his life, and this could only be effected by removing the upper portion of the femur, which, from its trifling mobility, induced the belief that a firm union was taking place between its under surface and that of the ilium, with which it had been long in contact, and the form of which was very apparent under the thin integuments with which it was covered. Considering, also, that as an entire destruction of every texture, which forms a healthy joint had taken place, no danger could be reasonably entertained from meddling with parts in their existing condition, and attempting the removal of the head of the displaced bone; and, further, that the strength of the boy, from the profuse discharge kept up by the caries of the bone was, never likely to be restored: I was induced, after mature reflection, to propose an operation for the removal of the upper part of the femur as far as it should be found in a state of caries, which, from examination with the probe, appeared to extend probably a little lower than the great trochanter. If this could be accomplished, it would set free the lower portion of the bone embedded on the opposite thigh, and enable me to draw outwards the whole limb, and possibly place the boy in a condition equally favourable with those cases where a similar disease had occurred, and in which a compensatory joint is formed, on which locomotion is effected with or without the aid of a crutch. I proposed to divide the integuments covering the bone, beginning above its head, which was easily detected, and carry it downward, in the centre, as low as might be found necessary, and separate the soft parts from the shaft of the bone towards either side. I then proposed to divide the bone at the lowest exposed part with a small saw and to elevate it with a lever from the dorsum of the ilium. I hoped that the wound would heal over the divided end of the bone, which (now being set free) might be brought into a straight line, and which motion would incline deeply into the wound the end of the divided bone. The wound itself was to be treated as a common incision with adhesive plaster and bandage, and rigid quietude. My colleague, the late Mr. Morel, saw the case, concurred in the proposition, and offered to be my assistant. The late Mr. William Smith, member for Norwich, and to whom the mother of the boy was well known, informed the late Sir E. Home of the proposed operation. The boy, at his request, was conveyed to St. George's Hospital; and, after an examination of the case with his colleagues, a written document, signed by him and them, was given to the mother of the boy, declaring that the contemplated operation would not only be useless, but impracticable; and, most likely, if attempted be attended with loss of life. I was not present at this consultation and only knew of it by being shown this document or protest by the boy's mother. Of course, with such a published declaration, I abandoned the case altogether. After the lapse of some months, Mr. Travers, whilst attending at Mr. Smith's house in the city, to which the boy West had been removed with his mother, was requested to look at him; and being told of the proposed operation by the mother, who was an exceedingly intelligent person, at once saw and understood the principles and plan of the proposition. He subsequently wrote me a note, expressing his entire concurrence in the measure, and kindly offered to assist me in the operation, notwithstanding the formidable protest which had been issued shortly before. Glad of the concurrence of so distinguished an individual, and my own opinion as to its practicability being unchanged, I gladly accepted of the offer. A lodging, in Westminster, was procured for the boy and his mother. We met in consultation, and an early day was fixed for the operation.

"In April, 1821, we met; and the boy being placed on a table of convenient height, I proceeded to divide the integuments covering the bone, carrying the incision from an inch above the head, directly along the middle line of the bone, about two inches below the greater trochanter: this was completed at one incision down to the surface of the bone. The integuments were dissected inwards and outwards, thus leaving the bone entirely bare, a little lower down than the lesser trochanter, which was distinctly visible. A spatula was now placed under that part of the bone which was intended to be sawn through, so as to protect the structures underneath. This was readily accomplished. A smaller spatula was then introduced into the space made by the saw, and used as a lever to raise the bone; which, with a little dissection, was removed from the dorsum of the ilium. No vestige of the acetabulum remained, neither was any caries of the ilium discovered. The thigh was now readily brought into a straight line, and the knee liberated from its position on the thigh. The wound was closed by adhesive plaster, and no portion of the bone was left exposed. Splints and an eighteen-tailed bandage were applied, and the limb placed in the straight position. The boy bore the operation well, and not more than two ounces of blood were lost. The head, neck, and trochanters, were very apparent, the caries being superficial, and not extending lower than the lesser one. The case proceeded very favourably, and, in a few weeks every sinuous opening had healed, and also the incision made in the integuments. The patient rapidly acquired strength and flesh. At the end of two months, I began to examine the parts to ascertain if they had formed any attachment to the surrounding structures; and, on attempting to move the limb in different directions, I discovered that the boy himself had the power of raising the thigh upwards, which power gradually increased, and, finally, a very extensive motion was accomplished by the spontaneous action of the muscles. I now proceeded to examine whether he could bear pressure upon this foot without inconvenience, which was the case, at the expiration of about four months from the time of the operation. He was put on crutches, and in a very short time could bear considerable pressure on the foot, and, at the end of a year, he could walk on a high stirrup without his crutches. Finally, it was clearly ascertained, that a new and useful joint had been formed, the boy being enabled to walk several miles without the aid of a crutch or stick. He acquired great latitude of motion, except in rotating the thigh outwards, and separating the thigh laterally outwards. He was apprenticed to a lady's shoemaker, and five years after the operation, he became phthisical, and died of diseased lungs in the Westminster hospital. The limb was removed with half the pelvis, and is in the possession of the Royal College of Surgeons; but the parts have not yet been examined, in order to ascertain the changes which had so usefully been employed in giving almost a perfect joint as a compensation for the original. The shaft of the femur appeared to have lost the power of further elongation; for, on frequent admeasurement during the life of the patient, it was discovered not to have increased in length. Probably the fact is not generally known, that bones do not increase in length after the amputation of their heads."

Excision of the Superior Maxillary Bone.

In the article Antrum, certain states of disease of this cavity are noticed, in which the only chance of cure depends upon the entire removal of the upper jaw-bone itself. I allude to osteo-sarcomatous, fibrous, and other tumours, which originate within the antrum, and by enlargement produce such an impairment of, and pressure upon, the surrounding organs and textures, as must ultimately prove fatal, unless a bold attempt be made to extirpate every part of the osseous texture, serving as a place of attachment to the swelling. Merely excising the alveoli, and front of the antrum, and then attacking the tumour with the knife, cautery, or caustic, generally fails. Baron Dupuytren was led to suspect that, by the excision of the upper jaw-bone, its total extirpation might be performed with a successful result. He was induced to form this opinion from the consideration of the examples on record, where the patients recovered after most severe mechanical injuries of the face, and necrosis, occasioning the destruction of the bone. Camper mentions a case, in which the whole of the bone came away, in consequence of necrosis, and the patient was cured. Acoluthus is stated, indeed, to have actually removed the upper jaw-bone for a tumour of the face, as long ago as 1693. Bidloo and Desault also anticipated Dupuytren in the belief, that the upper jaw-bone might be successfully extirpated, though they never undertook the operation themselves. The bulletins of the Faculty of Medicine at Paris prove that Dupuytren removed, at all events, the greater part of the bone, in 1824; but, as MM. Pillet and Gensoul contend, probably not the whole of it. M. Velpeau states that, in 1824, Mr. Rogers of New York removed both upper jaw-bones, as far back as the pterygoid processes, and this without making scarcely any incision through the lip. (See *Nouv. Elém.*, t. i. p. 549.) In 1826, Mr. Lizars also advocated the removal of the whole of the upper jaw-bone, and he performed the operation with success, in 1827, 1828, and 1830. In May, 1827, M. Gensoul, surgeon to the Hôtel Dieu, at Lyons, removed every part of this bone, together with the whole of the palate bone, on account of a fibro-cartilaginous tumour, and the patient got completely well. (See *Velpeau, Nouv. Elém. Méd. Opér.* t. i. p. 247; *Jh. Gensoul, Lettre Chir. sur quelques Maladies Graves du Sinus Maxillaire, &c*, p. 18. 8vo. Paris, 1833.)

In this work, M. Gensoul states that, several years previously, he had known patients die of very tedious operations, undertaken for the removal of cancerous and other tumours of the antrum. Reflecting on the fate of these unfortunate individuals, he was led to conclude, that others, labouring under similar diseases, might be cured by an operation, which consisted in freely denuding the antrum and upper jaw-bone, so as to be able to divide the sound parts, instead of meddling with the diseased ones, and of searching for the precise limits of the disease in the midst of blood and the remains of the affected textures. In short, he was induced to think, that the same principle should be acted upon in this operation as is followed in others, undertaken for the extirpation of cancerous tumours in general.

If the face of the skeleton be examined, it will be seen that the upper maxillary bone is fixed to the others only at three principal points:—1. By means of its nasal process, and at its connections with the os unguis and ethmoid bone. 2. By means of the orbitar process of the malar bone, as far as the spheno-maxillary fissure. 3. By means of the connection of the upper jaw-bone to its fellow, and to the palate bone. There is, indeed, a point of contact behind with the pterygoid process and palate bone; but this readily gives way on depressing the upper jaw-bone towards the mouth. In attacking these different points, no large vessel is injured; the trunk of the internal maxillary artery generally escapes, and, if wounded, may be readily tied, as was exemplified in the removal of the whole of the superior maxillary bone, performed by Mr. Liston in the North London Hospital, on the 27th Feb. 1836. If the hemorrhage during the operation were to be greater than calculated upon, the carotid artery might be compressed against the transverse processes of the cervical vertebræ. As for nerves, the only one of consequence necessarily divided is the superior maxillary; but it may be easily cut through before the bone is displaced, and then the laceration of it avoided, if judged advisable. This proceeding is strongly advocated by M. Gensoul; but, in the operations which I have seen performed, no preliminary division of the trunk of this nerve was practised, yet no ill consequences were the result.

The patient should be seated in a chair, with his head inclined backwards, and supported on the breast of an assistant. One of the incisor teeth is to be extracted at the place where the division of the bone is to be effected below. An incision is now to be made from the inner canthus of the eye down to the upper lip, which is to be cut through opposite the canine tooth; and the incision may then be made from a point five or six lines to the outer side of the external angle of the eye, down to the termination of the first. This will leave the parotid duct safe below it. The flap is next to be raised up as far as the lower border of the orbit. This plan is more simple, and less disfiguring, than that of M. Gensoul, who, after the first incision has been made, makes a second from the level of the nostril, to a point about four lines in front of the lobe of the ear; and then a third, extending from a point five or six lines behind the external angular process of the os frontis, down till it meets the termination of the second cut. The quadrilateral flap, thus formed, is then reflected on the forehead. M. Velpeau prefers an incision commencing at the commissure of the lips, and carried outwards, and then upwards towards the temporal fossa. This would not, however, expose the bone sufficiently for the section of its nasal process, for which purpose the perpendicular cut, from the inner canthus down to the upper lip, is very necessary. When the tumour is large, the circular sweep of the knife, as advised by M. Velpeau, and long ago practised by surgeons in this country, has advantages. The bone having been denuded, the next step is to divide the connection of the malar bone with the external angular process of the frontal, and immediately afterwards the zygomatic process of the malar bone. These excisions are best accomplished with Liston's cutting forceps, which should have long powerful handles; a construction found in the North London Hospital to answer better than jointed handled ones, which cannot be opened so wide, and have a tendency to slip off the bone instead of cutting it. The greater power with which they shut does not, therefore, seem to Mr. Liston to compensate for the inconvenience referred to. At all events, any additional power required can be obtained by simply lengthening the handles.

The next thing is to divide the nasal process of the superior maxillary bone, and the connection of the latter bone with the os unguis and os planum. For this purpose, one blade of the forceps is put within the orbit, the other within the nose, and the section accomplished.

This having been effected, and a cut made under the lower part of the palate, the upper jawbone is divided with the same instrument, at the place where the incisor tooth was extracted, together with the palatine process and palate bone, at the symphysis.

The bone being next pressed downwards, the slight connection with the pterygoid process, through the medium of the palate bone, gives way, when the upper jaw-bone, including the whole of the antrum and disease originating in it, is easily dissected out. The flap is brought down, and the wounds united with the twisted suture, aided with narrow strips of adhesive plaster. Mr. Liston prefers, as less irritating, strips of oiled silk, smeared with a solution of isinglass in brandy. These strips he does not usually remove till the wound is healed. The straight steel needles which he employs for the twisted suture, and the eye ends of which are tipped with red sealing-wax, and the points cut off with pliers directly after their introduction, are removed within the first forty-eight hours, leaving the many twisted silk to come away as soon as it loosens.

The following is Mr. Liston's description of the operation :—To expose the bone, the cheek is divided from the angle of the mouth to the origin of the masseter ; and a second incision made from the inner canthus, to the edge of the upper lip, near the mesial line, detaching the ala of the nose from the maxillary bone. The flap of the cheek, thus formed, is dissected up, and the nasal process of the maxillary bone, and the body of the os malæ are divided with a saw, or with strong cutting pliers. An incision having been made through the covering of the hard palate, near the mesial line, a small convex-edged saw is applied to the bone, and the alveolar process is cut through with the pliers, after extraction of the middle and lateral incisors. The bone is then pulled downwards and forwards, and its remaining adhesions separated by means of the knife or pliers. During the progress of the operation, the cut branches of the facial and temporal arteries are commanded by ligature or pressure, and the violence of the hemorrhage is moderated by pressure on the carotids. After removal of the bone, the deep vessels, branches of the internal maxillary, are secured either by ligature, or by firm pressure with charpie, or dossils of lint. The facial flap is replaced, brought together over the charpie by which the cavity is filled, and united by interrupted or convoluted suture. (See *Liston's Elem.* part ii. p. 160.)

In the examples of this operation which I have seen, any preliminary ligature of the common carotid artery would have been totally unnecessary. In one instance the internal maxillary was cut, but secured with the greatest facility. In a case, operated upon by Mr. Liston in the North London Hospital, not a single ligature was necessary.

It is an important object to prevent, as much as possible, the blood from flowing towards the throat, in the early part of the operation : hence the advantage of the sitting posture, and of Gensoul's plan of beginning with the division of the cheekbone, or zygoma, before the nasal process of the upper jaw-bone itself is attacked.

See *Jh. Gensoul*, Lettre Chir. sur quelques Maladies Graves du sinus Maxillaire et de l'Os Maxillaire Inférieur, 8vo. Paris, 1833. *Liston*, in Elements of Surgery, part ii. 8vo. 1831 ; also in Trans. of Royal Med. Chir. Soc. vol. xx. *G. J. Guthric*, in Lond. Med. Gaz. 1835, 1836. *A. L. M. Velpeau*, Nouv. Elém. de Méd. Opératoire. *G. Regnoli*, Sull' Estirpazione della Quasi Totalita dell' Osso Mascellare Superiore Sinistro per Osteo Sarcoma Memoria, 8vo. Pisa, 1832. *Professor Regnoli* makes only one external incision, which reaches from the external canthus to the commissure of the lips. Also Sull' Estirpazione d'un Osteo Sarcoma, &c. Pisa, 1831 ; and Mem. Intorno L'Asportazione di Gran. Parte dell' Osso Mascellare Superiore destro. This operation was performed in 1828. *J. F. Nivison*, Malignant Tumour succesfully removed from left Antrum, in Ed. Med. Surg. Jour. No. 83. *Irving*'s Obs. on the same, No. 84. *James Syme*, in Ed. Med. Surg. Journ. No. 100, p. 218, and No. 101, p. 238. Mr. *Lizar's* cases, I believe, are recorded in the London Med. Gaz.

Excision of Lower Jaw-Bone.

The practicableness of this operation was long ago evident enough from cases in which the greater part of the bone had been torn away by gun-shot injuries, or where it had exfoliated from necrosis. Boyer relates an instance in which it was torn away by machinery, and Wepfer quotes a case where it was amputated in his time. Mr. Anthony White, Surgeon to the Westminster Hospital, removed, at Cambridge, a considerable portion of the bone for an osteo-sarcoma many years ago. Unfortunately, the case was not published ; so that the revival and execution of the operation are generally referred to Dupuytren, who, in 1812, performed his earliest excision of the body of the lower jaw-bone. The parts removed weighed a pound and a half; the bone was affected with exostosis caries and necrosis, softened in several places, and combined with a hard fibrous fungus. The patient recovered, and was in perfect health twenty-one years after the operation. (*Dupuytren, Clinique Chir.* t. iv. p. 628.)

Subsequently to the year 1812, the operation has been frequently repeated by Dupuytren, Dr. Mott, Richerand, Lallemand, Delpech, Roux, Cusack, Martin, Gerdy, Magendie, Cloquet, Wardrop, Lisfranc, Warren, Gensoul, Græfe, Walther, Wagner, Randolph, Liston, Lawrence, Ph. Crampton, Velpeau, &c. By M'Clellan, Walter, and Græfe, nearly the whole of the bone has been taken away. By many other operators, disarticulation has been performed at one of the condyles. (See *Cusack*, in *Dublin Hospital Reports*, vol. iv. p. 13 ; *Liston's Elem.* part ii, &c.)

The method of performing the operation varies according to the extent of the disease. To expose the tumour, and allow the bone to be readily divided, there must necessarily be a free division of the soft parts. Previously, also, to fixing upon the plan of operation, the extent of the disease must be correctly ascertained. (See *Liston's Elem.* part ii. p. 224.) When only *the central portion of the body of the bone* was to be *removed*, the following was Dupuytren's plan :—the patient is seated, and his head held steady against the breast of an assistant, who is to stand behind him, and, if necessary, make pressure on the facial arteries. The surgeon standing in front of the patient and on his right side, is to take hold of the right portion of the lower lip with his left hand, while an assistant takes hold of the left portion. In this way, the lip is rendered tense, and separated from the other. With a common scalpel, an incision is then made completely through it, from above downwards to the base of the jaw. The next thing is to extend the wound through the skin and cellular tissue from this point down to the prominence of the os hyoides. Thus, two flaps are produced each of which is to be dissected up, as far as the extent of the disease requires, with the knife kept close to the bone, so that the facial arteries may not be wounded. The exact places having been ascertained to which the saw is to be applied, a tooth on each side must be extracted. The operator then taking a fine metacarpal saw, or one of Hey's, goes behind the patient, in which position the saw can be employed without any risk of its extremity being pushed against the palate. If requisite, the nose and upper lip may be protected with a piece of pasteboard. But, according to my observations, the best plan is only to make a groove, or partial division of the bone with the saw, and then to complete the section on each side with the cutting pliers, which expedite the business very considerably, and with no risk of injury to the contiguous parts. The bone, having been cut through on each side, the surgeon takes hold of the portion about to be removed, with his left hand, and while it is inclined forwards, he introduces a straight bistoury from below upwards, close behind it, and detaches it from the soft parts to the right and left, keeping the edge close to the bone. An assistant takes care to keep the tongue out of the way with a spatula, or the handle of a director. The vessels are now secured, the ends of the bone approximated to one another, and the flaps of skin united with sutures; care being taken to leave a small portion of the wound open below for the insertion of a bit of charpie, or lint, and as an outlet for the discharge, in the event of matter being formed.

If the portion of bone to be taken away were so extensive as to require the excision of a part of the integuments, Dupuytren made two incisions, one in each side of the lip, which were extended down, so as to meet at the os hyoides, and form together one in the shape of a V. When a perpendicular cut will not suffice, on account of the extent of the disease, it may by converted into a crucial wound, by making an incision along the base of the jaw.

One danger attending the operation is the retroversion of the tongue into the pharynx, as soon as the attachments of the genio-glossi muscles behind the symphysis have been cut. In this state, the tongue presses the epiglottis towards the glottis, and the patient is in imminent peril of suffocation. Indeed, in one case, M. Lallemand would have lost his patient had he not instantly performed tracheotomy. Hence, Delpech, before he divided the muscular connections of the tongue, behind the symphysis, used to seize the extremity with a double tenaculum, which was then entrusted to an assistant; and afterwards, in applying the sutures, he passed the thread of one of them through the frænum of the tongue and the skin together: if the interrupted suture were employed, or, supposing the twisted suture to be preferred, the ends of the thread, passed through the frænum, were twisted round the pins. In one case, Delpech introduced a piece of gold wire through the apex of the tongue, and fastened it to the contiguous teeth. The wire soon cut its way out, leaving a sufficient adhesion. In few instances, the circumstances of the disease may be such as to make it necessary to remove only a portion of the depth of the bone.

As the retroversion of the tongue, though not constant, is always a possible event, I concur with Malgaigne (*Man. de Méd. Opér.* p. 255) in the prudence of attending to the advice delivered on this subject by Delpech, or else of taking care not to cut through the insertions of the genio-glossi muscles, until the possible displacement of the tongue has been guarded against.

In the *excision of the whole of the horizontal portion of the lower jaw-bone*, one plan consists in making an incision along its base, and extending it a line or two beyond its angles. A large flap is then dissected up, and turned over the face. The bone is sawn on each side beyond the limits of the disease, and then detached from the soft parts which are connected with it behind, with the precautions and according to the directions above particularised.

If the disease were to extend high up in the rami, an incision should be made along the posterior edge of each ramus, so as to meet the extremities of the first wound.

Another method, specified by M. Malgaigne, is easier than the foregoing. After the horizontal incision has been made, a perpendicular one is made completely through the lower lip, and carried down in the middle line till it meets the horizontal wound. Both the lateral flaps are then dissected up.

In the *excision of one half of the horizontal portion*, several methods are adopted. In one, preferred by several British surgeons, and also by J. Cloquet, a horizontal incision is begun at the commissure of the lips, and terminates at the distance of one or two lines beyond the ramus of the jaw. To this first incision are added two vertical ones; one descending from the border of the lip to the base of the bone; the other taking a parallel course, descends behind the ramus to a point a few lines below the angle. The flap is dissected from above downwards; the soft parts are next detached from the inner surface of the jaw; and, lastly, the bone is sawn through. In the latter proceeding I particularly recommend Hey's saw, or a small metacarpal one, for making a groove in the bone, which can then be divided with the cutting pliers at one stroke, as practised by Mr. Liston, and always demonstrated by me in the Lectures on Operations at the London University.

Mr. Liston has likewise expressed himself, as follows, in favour of one method, in which the flap is made from above downwards:—"The cheek may be divided (says he) by passing through it a long narrow bistoury, close to the anterior edge of the masseter muscle, and carrying the instrument forwards, and through at the angle of the mouth. From each extremity of this incision, another is made downwards; the anterior one inclining forwards, the other backwards. By reflection of the flap thus formed, the bone is exposed more easily, rapidly, and perfectly, than by the former mode of incision, in which the flap is made by a semi-lunar incision along the base of the jaw." (See *Liston's Elem.* part ii. p. 225.)

In the plan adopted by Dr. Mott of New York, *two flaps are formed*. A curved incision is made, with its convexity downwards, from a point in front of the ear, and on a level with the condyle to the vicinity of the chin, below the commissure of the lips. The upper flap is raised and reflected on the face. A second incision, descending from the upper end of the first to the angle of the jaw, enables the surgeon to form a lower flap. The bone is sawn through, first in front, and then behind, as high up as the circumstances of the case require. If above a certain point, Dr. Mott recommends the inferior maxillary nerve to be cut through, before the bone is drawn outwards, and the lingual branch of the fifth pair to be carefully avoided.

A *third method*, which has the names of Cusack, Lisfranc, Liston, Malgaigne, &c., in its favour, consists in making, first, a vertical incision through the lip down to a point below the chin, and then a horizontal cut, extending from the first along the base of the jaw to two lines beyond its angle. The flap is then dissected off the tumour, in the direction from below upwards, and reflected on the face. The bone is then sawn through in front and behind, and the flap united with sutures. I am of opinion with M. Malgaigne, that this plan is more simple than the others; no lodgment of pus is likely to follow it; and the scar will produce but slight disfigurement. I recommend, however, the front portion of the bone to be divided before the posterior part of it, as facilitating the safe detachment of the mylohyoideus and other parts connected with its inner surface.

One method, described by Mr. Liston, is a modification of the foregoing:—"If the tumour is included between the lateral incisor tooth and last molar, on the same side, these teeth must be extracted to permit division at these points. A semilunar incision may then be made along the base of the jaw, the horns of the incision pointing upwards, and passing over the spaces which were occupied by the extracted teeth. The flap is dissected up, and the membrane of the cheek divided along the line of the incision. The bistoury is then carried along the inside of the bone, so as to divide the membrane of the mouth, and separate the attachments of the muscles. The tongue is pushed aside, and a copper spatula placed under the jaw at the part to be divided, in order that the soft parts may not be injured during the sawing. A small narrow saw, or one commonly known by the name of Hey's, is applied to the bone at the points where the teeth were extracted; and, by a few motions of this instrument, a notch is made of no great depth; a pair of strong cutting-pliers are placed in the track, and by them division of the bone is accomplished with equal neatness and much more rapidly than if the use of the saw had been continued. The pliers should be strong in every point, and the handles long, to afford the advantage of a powerful lever." The chain saw, he says, is not to be depended upon, and is slow in its operation. (See *Liston's Elem.* part ii. p. 224.)

A *fourth plan*, described by M. Malgaigne, may be applicable where the disease extends more in the direction backwards than forwards. In such a case, perhaps, it may be sufficient to make a semi-lunar incision along the posterior border of the ramus and the base of the bone, from the ear to the chin. Thus only one flap would be formed, and no cicatrix would be seen on the face.

M. Malgaigne lays it down as a maxim, that, in making the flaps in any of these operations, the skin and cutaneous muscles alone should be divided, and that the masseter should be cut through, and removed at the same height as the bone itself.

The facial artery is readily secured. All those operators who have had recourse to the ligature of the carotid artery, as a preliminary measure, have subjected their patients to a very needless proceeding.

Even in the *excision of one half the lower jawbone at its articulation* with the temporal bone, the ligature of the carotid artery is quite uncalled for. One plan consists in making an incision along the base of the jaw; a second one is then made perpendicularly through the lower lip down to the first; and a third begins at the zygoma, and extends behind the ramus. The flap is raised, and the fore part of the bone sawn through. The soft parts are then detached from its inner surface, and the tendinous attachment of the temporal muscle to the coronoid process cut through from within outwards. Lastly, the disarticulation of the condyle is effected: for this purpose, the external lateral ligament should first be divided; and, while the bone is depressed and twisted, in order to render the capsular ligament tense, the latter part may either be cut through with scissors, as recommended by M. Malgaigne, and then the probe-pointed bistoury used, or it may be divided at once, together with the external pterygoid muscle, by means of the probe-pointed bistoury kept close to the highest part of the inner side of the condyle, so as to leave the internal maxillary artery safe at the inner side of the neck of the bone. A great deal of the safety of this operation will depend upon the edge of the knife being kept close to the inner surface of the bone, so that the lingua branch of the fifth nerve may be left uninjured and upon attention being paid to the directions given for the disarticulation, which, after the insertion of the temporal muscle has been divided, is greatly facilitated by depressing the anterior part of the bone forcibly, and twisting the condyle itself. The hemorrhage will be chiefly from the facial, dental, and branches of the temporal and internal maxillary arteries.

Instead of making the flap exactly in the manner above described, I prefer making, first, the anterior perpendicular incision, and then another, beginning a little way in front of the lobe of the ear, extending down along the posterior border of the ramus, and then forward along the line of the base till it meets the lower termination of the first wound. This is more simple, and enables the surgeon to get more readily at the external lateral ligament.

In the horrible operation of extirpating the whole of the lower jaw-bone, the incision should extend from a point, a few lines in front of the lobe of one ear, down the posterior edge of the ramus, along the whole base, from one angle to the other, and then up to a point, a few lines in front of the lobe of the other ear. Care having been taken to prevent retroversion of the tongue, and the front portion of the flap raised, the soft parts behind the symphysis should be cut, and the bone sawn in this situation. Then the rest of the vast flap is to be raised on each side, and each half of the bone to be removed according to the foregoing directions.

On the subject of this operation, consult *Dupuytren*, Leçons Orales de Clinique Chir. t. iv. art. xv. 8vo. Paris, 1834. *W. Cusack*, in Dub. Hospital Reports, vol. iv. p. 1. *Ph. Crampton*, vol. cit. p. 537. *Jh. Gensoul*, Sur quelques Maladies Graves du Sinus Maxillaire, &c. 8vo. Paris, 1833. *Robert Liston*, Elements of Surgery, part ii. p. 223, 8vo. Lond. 1831. *J. F. Malgaigne*, Man. de Méd. Opér. 12mo. Paris, 1834. *A. L. M. Velpean*, Nouv. Elém. de Méd. Opér. t. i. p. 537, 8vo. Paris, 1832. *G. Regnoli*, Intorno l'Amputazione di Quasi la Meta della Mascella Inferiore Brevi Cenni. 8vo. Pisa,

1834. *Id.* Dell' Amputazione di una Porzione di Mascella Inferiore per Epulide Cancerosa ed Osteo-Sarcoma, 8vo. Pesaro, 1826.

For other observations connected with the excision of bones, see Amputation; Caries; Joints, Excision of; Necrosis; and Stumps.

Bones, Pathology of.

As a living texture, that of the bones is subject to many of the diseases which affect other parts endued with vitality, and in which the functions of circulation, innervation, absorption, and nutrition are continually going on. Thus it is liable to atrophy, hypertrophy, inflammation, suppuration, a change resembling ulceration, and another like mortification of other parts. The nerves, it is said, have never been demonstrated in the osseous texture; yet, if it be the seat of pain, our judgment must infer the existence of what may not be discernible by the eye. M. Sanson very aptly compares the organisation of bone to something between that of an organic and that of an inorganic body, its vitality being necessarily obscure, and correspondent to its constituent elements. The organic actions seem indeed to be carried on in it, with greater difficulty, the more the earthy matter in it predominates over the animal part. Thus, in children, irritation, inflammation, and every action in the osseous texture are quicker, than in old persons; because the bones in early life contain a greater proportion of animal matter than at a later period, when the phosphate of lime is more abundant. However, even in children, and still more conspicuously in adults and old persons, the diseases of the bones are generally marked by a slowness of character which has attracted the notice of all pathologists. Many weeks are required for the completion of a provisional callus, and nearly twelvemonth for that of a definitive one; while a few days, and often a few hours will suffice for the union of the wound of the soft parts. In consequence also of the inferior, or inconsiderable connection of the bones with the nervous system, they frequently appear to inflame and undergo disease, without involving the rest of the system in any sympathetic disturbance, till the irritation is propagated to the surrounding parts, or suppuration comes on. As M. Sanson observes, a necessary consequence of these facts is, that therapeutic means, even those of the most energetic kind, frequently have but little power over affections of the osseous tissue; and, if they prove effectual, it is not till after a long perseverance with them. (See *Sanson in Dict. de Méd. et de Chir. Prat.* t. 12, p. 308.) See Antrum, Cancer, Caries, Exostosis, Fragilitas, Joints, Mollities, Necrosis, Osteo-Sarcoma, Osteitis, Periostitis, Rickets, Spina Bifida, Stumps, Trephine, Venereal Disease, and Vertebræ.

The following works, relative to the pathology of bones, deserve notice: — *F. C. Spoendli*, De Sensibilitate Ossium Morbosa, 4to. Gott. 1814. *A. Murray*, De Sensibilitate Ossium Morbosa: (Ludw. Script. Neur. 4.) *O. Murray*, Diss. Acad. de Sensibilitate Ossium Morbosa. *Frank*. Del. Op. 12. *A. Bonn*, Tab. Ossium Morbosorum præcipue Thesauri Hoviani, fol. Amst. 1785-1788. *C. F. Clossius*, Ueber die Krankeiten der Knochen, 12mo. Tubing. 1799. *R. Nesbitt*, Human Osteogeny; two Lectures on the Nature of Ossification, 8vo. Lond. 1736. *Sandifort*, Museum Anatomicum, 2 vol. fol. Lugd. 1793. *Weidmann*, De Necrosi Ossium, fol. Francof, 1793. *Brodie*, On Diseases of Joints, 8vo. last ed. *J. Howship*, in Med. Chir. Trans. *Cruveilhier*, Anat. Pathol. fol. Paris, 1829-1835. *Dr. Cumin*, in Edin. Med. and Surgical Journ. No. 82. *J. B. Paletta*, Exercit. Pathol. 4to. Mediol. 1820-26. *B. Bell*, On Dis. of the Bones, 12mo. Edinb. 1827. *Dr. Carswell*'s Illustrations of the Elem. Forms of Disease, Fol. *Herbert Mayo*, Outlines of Human Pathology, ch. i. 8vo. Lond. 1835. *J. L. Sanson*, Art. Os. et Osteitis in Dict. de Méd. et de Chir. Prat. t. xii. Paris, 1834. And various other publications specified at the end of the article Necrosis.

BOUGIE is a smooth and generally a flexible instrument, which is introduced into the urethra for the cure of diseases of that passage (see Urethra); and so named from its bearing some resemblance to a wax taper, in French, bougie. However, the kinds of bougies are various, and some of them, employed in modern surgery, so far from having any similitude to a wax taper, are formed altogether of metal or catgut. They admit of being divided into those which are solid, and others, which are hollow, and more commonly named catheters. (See Catheter.)

The exact period when bougies were first used is a doubtful point. By Andrew Lacuna, a Spanish physician, the invention is ascribed to a Portuguese empiric; and, in 1551, the same author published what had been communicated to him upon this subject. In the year 1554, Amatus Lusitanus published a work, in which he refers to several witnesses to prove, that the empirical practitioner above alluded to had learned from him the use of bougies; while, on the other hand, he candidly owns that he himself was indebted to Aldereto of Salamanca, for a knowledge of these instruments. In 1553, however, Alph. Ferri, of Naples, endeavoured to show that his acquaintance with the utility of bougies reached as far back as 1548, and of course that he had anticipated Lacuna, and perhaps even Aldereto. But, instead of representing himself as the original inventor of bougies, he mentions that they were known to Alexander of Tralles, which, if true, carries back the invention to the sixth century. A. Ferri, also, before describing bougies and escharotic ointments, mentions various means for examining the state of the urethra, and, amongst other things, cylinders made of flexible lead, and of different sizes. Escharotic ointments for what were termed *carnosities* of the urethra, and bougies, were also described by Petronius in 1565, and afterwards by A. Paré. The oldest bougies, which were wicks of cotton, or thread, covered with wax, and escharotic plasters, were in time succeeded by those composed of linen smeared with wax. This change was made with the view of letting them have a hollow construction; an improvement, first noticed by Fabricius ab Aquapendente. (*Op. Chir.* 1617.)

In the middle of the 17th century, the manner of making and using bougies was well known to Scultetus, as appears from his *Armamentarium Chirurg. tab.* 13. *fig.* 9, 10.

Daran, and some of the older writers, attributed the efficacy of their bougies to the composition used in forming them. On the contrary, Mr. Sharp apprehended that it was chiefly owing to the pressure, which was made on the affected part; and Mr. Aikin adds, that, as bougies of very different compositions succeed equally well in curing the same diseases in the urethra, it is plain that with the exception of caustic bougies, they do not act from any peculiar qualities in their composition; but by means of some common property, probably their mechanical form.

Plenck recommended bougies of catgut, which may be easily introduced into an urethra, even when it is greatly contracted, their size being small, their substance firm, and dilatable by moisture. It is objected to catgut, however, that it sometimes expands beyond the stricture, and gives great pain on being withdrawn.

The invention of elastic gum bougies and catheters originated with Bernard, a silversmith at Paris, who, in the year 1779, presented some instruments of this kind to the Academy of Surgery, which period was prior to the date of the claim made by Professor Pickel of Wurzburg to the discovery. (See *Journ. de Méd. an.* 1785.)

For the composition of bougies, elastic resin, or gum, is thought to be very desirable, as it unites firmness and flexibility. Mr. Wilson, in his *Pharmacopœia Chirurgica*, is inclined to think that the art of making these instruments consists in finding a suitable solvent for the Indian gum. As this substance, if dissolved in æther, completely recovers its former elasticity, upon the evaporation of this fluid, it is supposed that æther, though rather too expensive, would answer, I find it positively asserted, however, in a modern work of great repute, that the idea of elastic gum being the substance really employed is a mistake, as the material used is nothing more than linseed oil, boiled for a considerable time, and used as a varnish or the silk, linen, or cotton tube. (See *Dict. des Sciences Méd.* art. *Bougie.*)

Solid elastic gum bougies sometimes cannot be introduced, when a wax bougie can; and from the trials which I have made of them, I conceive that it arises from their elasticity and continual tendency to become straight, when they reach the perineum, so that the point presses on the lower surface of the urethra. Hence, when the obstruction is on that side, it must be difficult to get the end of the bougie over it.

A few years ago, Mr. Smyth discovered a metallic composition, of which he formed bougies. These bougies are flexible, have a highly polished surface, of a silver hue, and possess a sufficient degree of firmness for any force necessary for the cure of strictures of the urethra. The advocates for the metallic bougies assert, that such instruments exceed any other bougies which have yet been invented, and are capable of succeeding in all cases, in which the use of a bougie is proper. They are either solid or hollow, and are said to answer extremely well as catheters; for they not only pass into the bladder with ease, but may also be continued there for any convenient space of time, and thus produce essential benefit. (*W. Smyth, Brief Essay on the Advantages of Flexible Metallic Bougies.* 8vo. Lond. 1804.) The greatest objection which has been urged against them is, that they are attended with a risk of breaking. I have heard of an eminent surgeon being called upon to cut into the bladder, in consequence of a metallic bougie having broken, and a piece of it passing into that organ, where it became a cause of the severe symptoms which are commonly the effect of a stone in the bladder. For the particulars of an interesting case, in which a metallic bougie broke in the urethra, the reader may consult *London Med. Repository*, vol. ix. No. 51. The manufacture of metallic bougies, however, is now brought to such perfection, that we rarely hear of their breaking; but it is most prudent not to be too bold with those of small diameter.

The bougie with its application, says Mr. Hunter, is perhaps one of the greatest improvements in surgery which these last thirty or forty years have produced. "When I compare the practice of the present day, with what it was in the year 1750, I can scarcely be persuaded that I am treating the same disease. I remember, when, about that time, I was attending the first hospitals in the city, the common bougies were either a piece of lead, or a small wax candle; and, although the present bougie was known then, the due preference was not given to it, nor its particular merit understood, as we may see from the publications of that time."

Of armed bougies, as well as of some other kinds, and of the manner of using bougies in general, I shall speak in the article Urethra, Strictures of.

See *J. Hunter*, on the Venereal Disease, p. 116. *Sharp*'s Critical Inquiry, chap. iv. *Aikin* on the External Use of Lead. *Daran*, Obs. Chir. sur les Maladies de l'Urètre, 12mo. Paris, 1748 and 1768. *Olivier*, Lettre dans laquelle on Démontre les Avantages que l'on peut retirer de l'Usage des Bougies creuses, &c. 8vo. Paris, 1750. *Desault*, Journ. de Chir. t. ii. p. 375, and t. iii. p. 123, 1792. *Smyth*'s Brief Essay on Flexible Metallic Bougies, 8vo. Lond. 1804. Dict. des Sciences Médicales, t. iii. p. 265, &c. 8vo. Paris, 1812.

BRAIN. (For concussion, compression of, &c. see Head Injuries of. For hernia of, see Hernia Cerebri.)

BREAST. (See Cancer; Mammary Abcess; Mamma, Diseases and Removal of; and Nipple.

BRONCHOCELE, (from βρόγχος the windpipe, and κήλη a tumour.) The Swiss call the disease *gotre*, or *goître*. Heister thought it should be named *tracheocele*. Prosser, from its frequency in the hilly parts of Derbyshire, called it the *Derbyshire neck*; and, not satisfied respecting the similitude of this tumour to that observed on the necks of women on the Alps, the *English Bronchocele*. By Alibert the disease is called *Thyrophraxia*.

1. The simple bronchocele, or thyrophaxia, is the most common form of the disease, and is a mere hypertrophy, in which the thyroid gland is simply enlarged, but not changed in structure. It is common in young girls and in women, has a regular even surface, a uniform resistance, and seldom presents any distinct divisions, or lobes. The integuments covering the part are quite unchanged. It is also well known to be in general free from danger; the office of the thyroid gland not being of such importance in the animal economy, as to be essential to the continuance of life. Alibert has seen one example, in which the tumour became cancerous and destroyed the mother of a family.

2. The compound bronchocele presents the greatest variety, and astonishes every beholder. Sometimes a more or less voluminous cyst is formed round it, filled with a pultaceous, or purulent matter. Sometimes, in compound bronchoceles, calcareous, tuberculous, melanotic, cartilaginous, and other adventitious substances are found. Once, in the situation of the thyroid gland, M. Andral met with a hard body, about the natural size of that gland. It consisted of two parts; one a true osseous texture, formed of very distinctly interlaced fibres, irregular and knobby on the surface; the other, a cavity, the parietes of which were composed of this osseous investment, and which had numerous slender filaments extend-

ing across it, like those of the spongy texture of bones. Between them was a small quantity of reddish fluid, of the consistence of syrup. (See *Andral, Précis d'Anat. Pathol.* t. i. p. 304.) In two cases, Alibert found, on the outside of the enlarged gland, a yellow fatty mass; and, in a third instance, the gland itself formed a true sarcoma. (*Nosol. Nat.* t. 1. p. 464, 465, *folio, Paris*, 1817.)

Simple *bronchocele* always signifies, in this country, hypertrophy of the thyroid gland, which, with the disease of the surrounding parts, sometimes not only occupies all the space from one angle of the jaw to the other, but forms a considerable projection on each side of the neck, advancing forward a good way beyond the chin, and forming an enormous mass, which hangs down over the chest. The swelling, which is more or less unequal, generally has a soft spongy elastic feel, especially when the disease is not in a very advanced state; but no fluctuation is usually perceptible, and the part is exceedingly indolent. The skin retains nearly its ordinary colour; but, when the tumour is of very long standing and great size, the veins of the neck become more or less varicose.

It is stated by Dr. Sacchi, of Treviglio, that simple hypertrophy may often be cured; but, if not dispersed, the gland becomes in time variously altered; assuming either a scrofulous or an encysted character. The scrofulous goître frequently attains an immense size; but does not give rise to corresponding inconvenience or danger. It is generally lobulated. In time, one or more of these lobes may become soft, and present a feel of fluctuation. This constitutes the soft, hydatid, or lymphatic goître of authors. The structure has become vesicular, and contains fluid, which may be watery or albuminous:—in a few cases it is more like milk or pus. Some goîtres, however, having a feel like that of fluctuation, really have the consistence of a spongy substance, like that of the placenta, and do not contain fluid. According to Dr. Sacchi, some goîtres undergo a partial softening, and it is a mistake to suppose, that they always become harder and harder the longer they continue.

According to Prosser, the tumour generally begins between the eighth and twelfth years. It enlarges slowly during a few years; but, at last, it augments rather rapidly, and forms a bulky pendulous tumour. Women are far more subject to the disease than men, and the tumour is observed to be particularly apt to increase rapidly during their confinement in childbed. Sometimes bronchocele affects the whole of the thyroid gland, that is to say, the two lateral lobes, and the intervening portion; and in this kind of case, it is not unusual to remark three distinct swellings, for the most part of unequal size. Frequently, only one lobe is affected; while, in many other cases, the three portions of the thyroid gland are all enlarged, and so confounded together, that they make, as it were, only one connected globular mass. Finally, in some dissections, the thyroid gland has been found quite unchanged, the whole of the tumour having consisted of a sarcomatous disease of the adjacent lymphatic glands and cellular membrane. (*Postiglione*, p. 21.) When only one lobe of the thyroid gland is affected, it may extend in front of the carotid artery, and be lifted up by each diastole of this vessel, so as to have the pulsatory motion of an aneurism. (*A. Burns's Surgical Anatomy of the Head and Neck*, p. 195, *and Parisian Chirurgical Journ.* vol. 2. p. 292, 293.) Alibert believes that he first made the remark, that the right lobe was more frequently enlarged than the left. (*Nosol. Nat.* t. 1. p. 465.) The same thing was invariably noticed in every case seen by Mr. Rickwood in the neighbourhood of Horsham in Sussex. (See *Méd. and Phys. Journ.* for August, 1823.)

The ordinary seat of bronchocele, as Flajani remarks, is the thyroid gland; but sometimes cysts are formed in the cellular membrane. (*Collez. d'Oss.* t. 3. p. 277.) And Postiglione also observes, that the swelling is sometimes encysted, and filled with matter of various degrees of consistence, resembling honey, &c.; in some cases, it is emphysematous, or filled with air; and, in other instances, it is sarcomatous, having the consistence of a gland, which is enlarged, but not scirrhous. These different characters prove, says he, that the treatment ought not to be the same in all cases. (*Memoria sulla Natura del Gozzo*, p. 20.)

Bronchocele is common in some of the valleys of the Alps, Apennines, and Pyrennees. Indeed, there are certain places where the disease is so frequent, that hardly an individual is totally exempt from it. Larrey, in travelling through the valley of Maurienne, noticed, that almost all the inhabitants were affected with goîtres of different sizes, whereby the countenance was deformed, and the features rendered hideous. (*Mém. de Chir. Mil.* t. i. p. 123.) And Postiglione remarks, that in Savoy, Switzerland, the Tyrol, and Carinthia, there are villages, in which all the inhabitants without exception have these swellings, the position and regularity of which are there considered as indications of beauty. (*Memoria sulla Natura del Gozzo*, p. 22.) In many the swelling is so enormous, that it is impossible to conceal it by any sort of clothing. A state of idiotism is another affliction, which is sometimes combined with *goître*, in countries where the latter affection is endemic. However, all who have the disease, are not idiots, or cretins as they have been called; and in Switzerland, and elsewhere, it is met with in persons, who possess the most perfect intellectual faculties. When bronchocele and cretinism exist together, Foderé, and several other writers, ascribe the affection of the mind to the state of the thyroid gland. (See *Traité sur le Goître et le Cretinisme*, 8vo. Paris, an. 8.) However, this opinion appears to want foundation, since the mental faculties are from birth weak, and in many the idiotism is complete where there is no enlargement of the thyroid gland, or when the tumour is not bigger than a walnut, so that no impediment can exist to the circulation to or from the brain. (*Burns on the Surgical Anatomy of the Head and Neck*, p. 192.) The direct testimony of Dr. Reeves also proves, that in countries where cretins are numerous, many people of sound and vigorous minds have bronchocele. (See *Dr. Reeves's Paper on Cretinism, Edin. Med. and Surg. Jour.* vol. v. p. 31.) Hence, as Mr. A. Burns remarked, the combination of bronchocele and cretinism must be considered as accidental; a truth that seems to derive confirmation from the fact, that, in some parts of this country, bronchocele is frequent, where cretinism is seldom or never seen.

Bronchocele is not confined to Europe: it is met with in almost every country on the globe. Professor Barton, in his travels amongst the Indians settled at Oneida in the state of New York, saw the complaint in an old woman, the wife of the chief of that tribe. From this woman Barton learned, that bronchoceles were by no means uncommon amongst the Oneida Indians, the complaint existing in several of their villages. He found also that the disease resembled that seen in Europe in respect to its varieties. He did not indeed himself see the pendulous bronchocele, which descends over the breast; but he understood, that it was not uncommon amongst the women on the banks of the Mohawk river, who wore a particular dress for its concealment. In North America, bronchocele attacks persons of every age but it is most frequently seen in adults; a difference from what is noticed in Europe. Bronchocele is said to be frequent in Lower Canada. Bonpland, the companion of Humboldt, informed Alibert, that the disease was endemic in New Granada, and that it prevailed in such a degree in the little towns of Honda and Monpa, on the banks of the Magdalen river, that scarcely any of the inhabitants were free from it. The blacks, and those who led an active laborious life, however, are reported to escape the complaint. Some of the natives of the Isthmus of Darien are said to be terribly disfigured by it. (*Alibert, Nosol. Nat.* t. i. p. 469. *Also, Observations sur quelques Phénomènes peu connus qu'offre le Goître sous les Tropiques dans les Plaines et sur les Plateaux des Andes, par A. de Humboldt, in Journ. de Physiologie, par F. Magendie,* t. iv. p. 109. *Paris,* 1824.)

In European women, bronchocele usually makes its appearance at an early age, generally between the eighth and twelfth year, and it continues to increase gradually for three, four, or five years, and is said sometimes to enlarge more during the last half year, than for a year or two, previously. It does not generally rise so high as the ears, as in the cases mentioned by Wiseman. Sometimes, however, this happens, as we see in the case of Clement Desenne, of whom Alibert has given an engraving. In this patient, a part of the tumour, as large as a hen's egg, projected into the mouth. (*Nosol. Nat.* t. i. p. 466.) The swelling extended from the ears to the middle of the breast. A seton produced a partial subsidence of it; but, when it was withdrawn, the orifices closed. After two years more, the swelling became painful, suppuration took place, and fifteen pints of matter were discharged; and six ounces every day after the swelling had burst, came away with the dressings for three months; but, notwithstanding all this suppuration and more afterwards, the tumour was only partially lessened. The disease mostly has a pendulous form, not unlike, as Albucasis says, the flap, or dewlap, of a turkey-cock, the bottom being the largest part of the tumour. Alibert mentions a case in which the swelling hung down to the middle of the sternum, and the large mass, which was quite a burthen to the patient, used to become hard, and, as it were, frozen, in very cold weather. This author, however, cannot be right, when he adds, that it was an inert body, *destitute of vitality*. (*Nosol. Nat.* t. i. p. 466.) In another curious instance, the tumour formed a long cylinder, which reached down to the middle of the thigh, the diameter becoming gradually smaller downwards. (P. 468.) The common seat of bronchocele is the thyroid gland; but, frequently, the surrounding cellular membrane is more or less thickened, and contributes to the swelling. Sometimes also the neighbouring lymphatic glands are affected, when its base is widened, and extends from one side of the neck to the other. In this circumstance, the swelling gradually loses itself in the surrounding parts, and is not circumscribed, as in ordinary instances. (*Postiglione, Mem. sulla Natura del Gozzo,* p. 20.) It is soft or rather flabby to the touch, and somewhat moveable; but, after a few years, when it has ceased enlarging, it becomes firmer and more fixed. When the disease is very large, it generally occasions a difficulty of breathing which is increased by the patient's catching cold or attempting to run. In some subjects the tumour is so large, and affects the breathing so much, that a loud wheezing is occasioned; but there are many exceptions to this remark. Sometimes, when the swelling is of great size, patients suffer very little inconvenience; while others are greatly incommoded though the tumour is small. In general the inconvenience is trivial. The voice is sometimes rendered hoarse; and, in particular cases, the difficulty of speech is very considerable. (See *Flajani, Collez. d'Oss.* t. iii. p. 271.)

The difficulty of respiration, produced by the pressure of the tumour, and the enlargement of other glands, as this author remarks, is the most dangerous effect of the disease, since, by disordering the pulmonary circulation, it renders the pulse irregular and intermittent, and a strong throbbing is excited in the region of the heart, followed by fatal disease of the lungs themselves; consequences often not suspected to have any connection with the bronchocele, though it is in reality the immediate cause of them. (Vol. cit. p. 278.)

The causes of bronchocele are little known. To the doctrine, that bronchocele is brought on by the earthy impregnation of water used for drink, the following objections offer themselves: — 1. The water of Derbyshire, in districts where this disease is considered endemic, contains much supercarbonate of lime; but that in common use about Nottingham, where the disease is also prevalent, is impregnated with sulphate of lime. However, that the disease is not produced by water, impregnated with sulphate of lime, is evident; for, as Alibert observes, the waters of St. Jean, St. Sulpice, and St. Pierre, where bronchocele is frequent, contain much less of this earth than the waters of Upper Maurienne, where the disease is hardly ever noticed, though the houses are built upon a vast quarry of gypsum. The same fact was observed by Bonpland in New Granada. (*Nosol. Nat.* t. i. p. 471.) Nor, as Foderé explained, can the cause of the disease be correctly referred to the use of any particular kind of food. Certain localities, however, seem to contribute to its frequency; for this author observes, that the disease is not prevalent in very high places, nor in open plains; but that it becomes more and more common, as we descend into deep valleys made by torrents, where there is a good deal of marsh and abundance of fruit trees. The air is here constantly humid. 2. Abstinence from unboiled water does not diminish, or interrupt the gradual progress of the disease. 3. Patients are cured of the disease, who still continue to drink water from the same source as before, without taking any precaution, as boiling, &c. 4. The disease in this country is less frequently found among men. 5. Many instances may be related of a swelling in the neck, sometimes very painful, and generally termed bronchocele, being produced very suddenly, by difficult parturition, violent coughing, or any other unusually poweful effort. (See *Edin. Med. and Surgical Journal*, vol. iv. p. 279.) When the gland is suddenly enlarged during a violent exertion, the distention is said to be produced by the passage of air from the trachea into the substance of the thyroid gland and surrounding cellular membrane. But whether this statement be a fact or not, it is unquestionably true, that, in many patients, the tumour always increases when they speak loud, sing, or make any effort. (*Flajani, Collez. d'Oss. &c.* t. iii. p. 276; *and Postiglione*, p. 24.) The disease is sometimes seen in scrofulous subjects; but there is every reason to believe, that it is quite independent of the other disorder, as Prosser, Wilmer, and Kortum have particularly explained. The following are some points of difference between bronchocele and scrofula, as indicated by Dr. Postiglione:—1. The true bronchocele is simply a local disease of the neck, the constitution being unaffected. On the contrary, scrofula extends its effects to the whole system, attacking not only the lymphatic glands, but also the muscles, cellular membrane, ligaments, cartilages, and bones. 2. Both diseases chiefly occur in young subjects; but bronchocele often begins at a later age than scrofula, and does not, like the latter, spontaneously disappear, as the patient approaches puberty and gains strength. 3. Scrofulous glands often suppurate and ulcerate: bronchocele more rarely undergoes these changes. 4. The thickening of the upper lips of scrofulous subjects is not an attendant on bronchocele; and, while the former patients generally enjoy their mental faculties in perfection as long as they live, the latter disease in certain countries is often joined with cretinism. Scrofula is likewise always hereditary, while bronchocele is not so: no healthy persons become scrofulous by living a long while amongst scrofulous patients, but many individuals contract bronchocele by going from a country where this disease is unknown, and taking up their residence in places where it abounds. 5. Nature alone often cures scrofula, while art is rarely successful; on the contrary, bronchocele is seldom cured by nature, but very frequently by art. 6. The muriate of lime, recommended by Fourcroy for the cure of scrofula, is always useless; but, in bronchocele, it proves a valuable remedy. (*Postiglione, Memoria sulla Natura del Gozzo, &c.* p. 25.) The error of confounding bronchocele with scrofula is now generally acknowledged. At the Hospital St. Louis, says Alibert, scrofulous patients are numerous, while those with bronchocele are very rare. (*Nosol. Nat.* t. 1. p. 465.) In Derbyshire, Genoa, and Piedmont, bronchocele has been attributed to drinking water cooled with ice. To this theory, many of the objections, concerning the earthy impregnation of water, stand in full force; with this additional reflection, that "in Greenland, where snow-water is commonly used, these unsightly protuberances are never met with; nor (says Watson) did I ever see one of them in Westmoreland, where we have higher mountains and more snow than in Derbyshire, in which country they are very common. But what puts the matter beyond a doubt is, that these wens are common in Sumatra, where there is no snow, during any part of the year." (*Watson's Chemical Essays*, vol. ii. p. 157.) The above opinion was also refuted by Foderé, who remarks, that the Swiss, who reside at the bottom of the glaciers, are the least subject to the disease. Bronchoceles are also said to be unkown in Lapland.

Respecting the influence of particular water in bringing on the disease, Dr. Odier gives credit to the opinion; because it has appeared to him, that distilled water prevented the increase of the tumour, and even tended to lessen its bulk. (See *Manuel de Médecine Pratique*, 8vo. *Genev.* 1811.) However, that every explanation, hitherto devised of the causes of bronchocele, is quite unsatisfactory, is fully proved by the observations of the celebrated Humboldt. Persons afflicted with bronchocele (he remarks) are met with in the lower course of the Magdalen river (from Honda to the conflux of the Cauca); in the upper part of its course (between Neiva and Honda); and on the flat high country of Bogota, six thousand feet above the bed of the river. The first of these three regions is a thick forest, while the second and third present a soil destitute of vegetation; the first and third are exceedingly damp, the second is peculiarly dry: in the second and third regions, the winds are impetuous; in the first, the air is stagnant. To these striking differences we will add those relative to temperature. In the first and second regions, the thermometer keeps up, all the year, between 22 and 33 centigrade degrees; in the third, between 4 and 17 degrees. The waters drunk by the inhabitants of Mariquita, Honda, and Santa Fé de Bogota, where bronchoceles occur, are not those of snow; and issue from rocks of granite, freestone, and lime. The temperature of the waters of Santa Fé and Mompox, drunk by those who have this disease, varies from nine to ten degrees. Bronchoceles are the most hideous at Mariquita, where the springs, which flow over granite, are, according to my experiments, chemically more pure than those of Honda and Bogota, and where the climate is much less sultry, than upon the banks of the Magdalen river. Perhaps it may be thought, that the atony of the glandular system (?) depends less upon the absolute temperature than upon the sudden refrigeration of the atmosphere, the difference of temperature in the night and day; but, in the Magdalen valley, where the constancy of low tropical regions prevails, the extent of the scale that the thermometer pervades in the course of the whole year, is only a small number of degrees, &c. (*Humboldt, in Journ. de Physiologie, par F. Magendie*, t. iv. p. 116.)

The same distinguished observer confirms previous accounts of the variety of bronchoceles amongst the original copper-coloured natives of America and negroes. It appears, also, that in South America, bronchocele is progressively extending itself from the lower provinces to the flat elevated regions of the Cordilleras; and this, in so serious a degree, that in 1823 the subject was adverted to in a report made to Congress by M. Restreppo, one of the Colombian ministers.

An observation, lately made by an intelligent writer, would lead one to conclude, that cretinism depends upon malformation of the head. Speaking of goître, as it appears among the inhabitants of the valley of Maurienne, Baron Larrey informs us, that, in many of these people, with this frightful deformity is joined that of the cranium, of which the smallness and excessive thickness are especially remarkable. (*Mém de Chir. Milit.* t. i. p. 123.) Dr. Leake thinks that tumours of this sort may be owing to the severity of the cold damp air, as they generally appear in winter, and hardly ever in the warm dry climates of Italy and Portugal. The latter part of the observation, however, is not correct; for Dr. Postiglione and other Italian writers assure us, that the disease is extremely common in some of the warmest parts of Italy. "*Quì in Napoli, e per tutto il regno si veggono molti gozzuti, ma non in numero tale, come in Casoria, ed in pochi altri villaggi.*" (P. 21.) Prosser is inclined to consider the bronchocele as a kind of dropsy of the thyroid gland, similar to the dropsy of the ovary; and he mentions, that Dr. Hunter dissected one thyroid gland, which had been considerably enlarged, and contained many cysts filled with water. These, he erroneously concludes, must have been hydatids. Dr. Baillie remarks, that when a section is made of the thyroid gland, affected with this disease, the part is found to consist of a number of cells, containing a transparent viscid fluid.

In all probability, the ordinary bronchocele is entirely a local disease, patients usually finding themselves, in other respects, perfectly well. The tumour itself frequently occasions no particular inconvenience, and is only a deformity. There is no malignancy in the disease, and the swelling is not prone to inflame or suppurate, though, as Dr. Hunter remarks, abscesses do occasionally form in it. Alibert's case of bronchocele becoming cancerous is rather uncommon. Mr. Gooch never knew life to be endangered by this sort of tumour, however large; a remark very much at variance with the observations of some other practitioners; but he had seen great inconvenience arise from it, when combined with quinsy. In fact, the pressure of a large bronchocele may not only greatly afflict the patient, by rendering respiration difficult, but actually cause death by suffocation. (See *Obs. sur un Goître volumineux, comprimant la Trachée-artère par L. Winslow, in Bulletin de l'Athénée de Méd. &c.*) "Some persons, as Alibert remarks, have the disease all their lives, without suffering any inconvenience from it; some experience a suffocating oppression of the breathing; and in others there is an impediment in the circulation, and a tendency to apoplexy, arising from the strangulation which afflicts them." (*Nosol. Nat.* t. i. p. 466.) Dr. Hunter says, that the bronchocele frequently appears two or three years before or after the commencement of menstruation, and that it sometimes spontaneously disappears, when this evacuation goes on in a regular manner. Mr. A Burns affirms the same thing. On the contrary, according to Prosser, this change in the constitution hardly ever affects the tumour.

Scarpa believed that the thyroid gland was never primarily affected with true scirrhus, maintaining, that the disease was always consecutive to cancer, or scirrhus of the tongue, œsophagus, parotid or submaxillary gland. Dr. Sacchi relates a case, however, proving that, on this point, Scarpa was incorrect; and he also details an instance of fungus hæmatodes of the thyroid gland, Of this last disease, there are at least two specimens in the Museum of University College.

Besides the forms of goître, already noticed, there is another sometimes termed *aneurismatic*, and consisting of an extraordinary development of the thyroid arteries and their branches. Every point of the tumour has a strong pulsation, not however, like that of an aneurism, but giving a sensation as if the blood were flowing very rapidly into numerous vessels, with an obscure buzzing noise, or tremulous murmur, which is more distinct over the thyroid trunks. I think, a case of this description was once shewn to me by Mr. Pilcher. In two cases recorded by Dr. Sacchi, the tumours had existed many years, and begun during the efforts of parturition.

Treatment of Bronchocele.

That certain localities, perhaps not yet correctly understood, contribute to the origin of this disease, is well proved by a fact stated by Alibert, viz. that change of air has more effect on the complaint than medicines, as he has known many Swiss ladies, who came to Paris with bronchoceles, in whom the tumour subsided after they had resided some time in that city. (*Nosol. Nat.* t. i. p. 473.)

A blister, kept open, has put a stop to the growth of the tumour; but, this method is not much followed at present, as better plans of treatment have been discovered. A few years ago the favourite mode of curing bronchocele, consisted in giving internally burnt sponge, and occasionally a calomel purge, at the same time that frictions were made upon the tumour itself. The utility of burnt sponge in the treatment of bronchocele, as Dr. Coindet and others have now fully proved, depends upon the iodine in its composition.

The efficacy of burnt sponge was thought to be greatest when exhibited in the form of a lozenge, composed of ten grains of this substance, ten of burnt cork, and the same quantity of pumice stone. These powders were made into the proper form with a little syrup, and the lozenge was then put under the tongue and allowed to dissolve. To the latter circumstance much importance was attached. Some practitioners gave a scruple of burnt sponge alone, thrice every day; while others added a grain of calomel to each dose. A purge of calomel was ordered about once a week, or fortnight, as long as the patient persevered in the use of the calcined sponge; but, when mercury was combined with each dose of this medicine, no occasional purgative was deemed requisite.

External means may very materially assist the above internal remedies. Frequently rubbing the swelling with a dry towel, bathing the part with cold water; rubbing the tumour two or three times a day with the liq. ammon. acet. or the camphor liniment, are the best steps of this kind which the surgeon can take.

"In the treatment of bronchocele," says Mr. A. Burns, "repeated topical detraction of blood from the tumour is highly beneficial. Electricity also has sometimes a marked effect; but, there is no remedy which I would more strongly advise than regular and long-continued friction over the tumour. By perseverance in this plan, a bronchocele, treated in London, was materially reduced in the course of six weeks. Its good effects I have likewise witnessed myself; and it is a remedy highly recommended by Girard, in his '*Traité des Loupes.*' It has also been much used in scrofulous tumours by Mr. Grosvenor of Oxford, and by Mr. Russell, of Edinburgh." (*Surgical Anatomy of the Head and Neck*, p. 204.) Mr. A. Burns recommends the friction to be made with flannel, covered with hair-powder, and the part to be rubbed, at least, three times a day, for twenty minutes.

In two cases of bronchocele, related by Dr. Clarke, the patients were cured, by "the steady use of the compound plaster of ammoniac and mercury, conjoined with the internal exhibition of burnt sponge, and occasional purgatives." (See *Edin. Med. and Surgical Journal,* vol. iv. p. 280.)

We learn from Professor Odier, that, in Geneva, bronchocele used to be cured by burnt sponge, exhibited in powder, or infused in wine, and combined with purgatives, to prevent the cramps of the stomach which sometimes accompany the disappearance of the swelling. Muriate of barytes has likewise been recommended. (See *Manuel de Médecine Pratique.*)

Mr. Wilmer, credulously imputing great influence to the changes of the moon, used to begin with an emetic, the day after the full moon, and to give a purge on the ensuing day. The night following, and seven nights successively, he directed the above-mentioned lozenge to be put under the tongue at bed-time, and administered every noon a bitter stomachic powder. On the eighth day, the purge was repeated, and, in the wane of the succeeding moon, the whole process except the emetic was renewed. (*Cases in Surgery, Appendix.*) This, which is often called the Coventry plan of treatment, is said to be greatly assisted, by rubbing the tumour with an ointment containing tartar emetic.

Prosser succeeded with his medicines, though the patient was nearly twenty-five years old, and the swelling had existed more than twelve years. It is said that no instance of cure has been known after the patient was twenty-five. Prosser orders one of the following powders to be taken early in the morning, an hour or two after breakfast, and at five or six o'clock in the evening, every day, for a fortnight, or three weeks. The powder may be taken in a little syrup, or sugar and water: ℞ Cinnab. opt. levigat. milleped. ppt. et pulv. ā ā gr. xv. Spong. calcin. ℈. M.

These powders should be taken for two or three weeks, and then left off for a week or nine days, before a repetition. At bed-time every night, during the second course of the powders, some purgative pills, composed of mercury, the extractum colocynthid. comp. and rhubarb, are to be administered; and, in general it will be proper to purge the patient with manna, or salts, before beginning with the powders. Prosser erroneously puts no faith in external applications.

Some have recommended giving two scruples of calcined egg-shells, every morning, in a glass of red wine; half a drachm of the sulphuret of potash every day, dissolved in water; or ten, or fifteen drops of the *tinct. digit.* twice a day, the dose being gradually increased. Muriated barytes, cicuta, and belladonna, have also been exhibited. Postiglione commends the muriate of lime as a medicine possessing great efficacy. The remedy is made into a bolus with honey, to which is sometimes added burnt sponge with cinnamon in powder. He employs also frictions with flannel, liniments, and sometimes purges with calomel. The bolus is placed under the tongue, and allowed to dissolve there. (P. 59. &c.)

Sir J. Wylie, physician to the Emperor of Russia, prescribes three grains of the submuriate of mercury, three of the ammoniacal muriate of iron, four of burnt sponge, and ten of the bark of laurus cassia, divided into twelve doses, one of which is given twice a week, with a gentle anodyne at night. He also directs twenty-four lozenges to be made, by triturating an ounce of burnt sponge, with an equal quantity of the powder of gum arabic, and fifteen grains of cinnamon, first blended with a sufficient quantity of the syrup of orange-peel. One of these lozenges is put under the tongue daily, and allowed to dissolve there. Lastly, to the tumour itself, he applies a plaster, composed of half an ounce of litharge, a drachm of the submuriate of mercury, and ten grains of antim. tartariz. (*Alibert, Nosol. Nat.* t. i. p. 474.)

The virtues of burnt sponge, in the cure of certain forms of bronchocele, are now ascertained to be owing to the iodine which it contains. Iodine was discovered in 1813 by Courtois, manufacturer of saltpetre at Paris; but six years elapsed before it was tried as a medicine. From the first memoir of Dr. Coindet, addressed in 1820 to the Helvetian Society of Natural Sciences, it appears, that, as he was searching for a formula in the work of Cadet de Gassicourt, he found, that Russell had recommended the ashes of the *fucus vesiculosus,* or bladder wrack, under the name of Æthiops vegetabilis, for the cure of bronchocele; and he was led from analogy, between this substance and burnt sponge, so long celebrated for its efficacy in the treatment of bronchocele, to suspect that iodine was the active principle of both. "The great and unequalled success which resulted from its use in the treatment of bronchocele, at once indicated the power of iodine as a therapeutic agent, and encouraged Dr. Coindet to pursue his researches in rendering it an efficient article of the materia medica; and about the close of the same year, when Dr. Coindet had employed iodine in treating goître for six months at least, his conjecture was confirmed by the discovery which Dr. Fyfe of Edinburgh made, that this substance was actually contained in the ashes of the burnt sponge, &c.

"It has been generally understood among the profession, that the happy conjecture, which introduced iodine into medical treatment, originated with Dr. Coindet, of Geneva; yet, we find that his claim to this honour is disputed by one of his countrymen, Dr. J. C. Straub, of Hofwyl, in the Canton of Berne.

"Dr. Straub, whose communication is found in Professor Meisner's Physical Intelligence of the General Helvetian Society for 1820, states, that, before the discovery of iodine, attempts had been made to compound a substitute for burnt sponge, but without success; and that this failure, and his observation of the similarity of smell between iodine, burnt sponge, and other marine productions, led him to suspect the existence of iodine, or its salts, in these substances, and that its absence in the artificial compounds was the cause of failure in these experiments. This conjecture, which appears to have been made previously to 1819, led Dr. Straub to examine the real burnt sponge; and he informs us, that, though his time did not permit him to ascertain exact quantities, yet he obtained from $1\frac{1}{2}$ oz. of burnt sponge, as much iodine as to render his conjecture probable, and to be astonished that the ingredient should have escaped notice. He was therefore at once induced to think of its use in medicine; and in the same paper, from which we obtain these facts, impressed with the poisonous quality ascribed by Orfila to iodine, he recommended, first the trial of its salts, especially the hydriodates of soda and lime, and then that of the substance itself.

"The communication of Dr. Straub is dated Dec. 1819, and was actually published in Professor Meisner's periodical work in February, 1820; five months, at least, before the first memoir of Dr. Coindet was communicated to the Helvetian society of Natural Sciences at Geneva. It is unnecessary to have recourse to any supposition of injustice done to Dr. Straub; much less would it be right to deprive Dr. Coindet of the merit of originality in substituting the direct and certain action of iodine for the irregular, and sometimes inert, qualities of burnt sponge in the treatment of goître. Coincidence of this kind is not uncommon in science: in the present instance, the ingenuity of Dr. Straub does not diminish the merit of Dr. Coindet." (See *Edin. Med. and Surg. Journal*, No. 80. p. 210, &c.)

That iodine is a medicine of considerable efficacy in bronchocele, not a doubt can be entertained, after the many cases now recorded in proof of the fact; and that it is useful in some other chronic tumours, especially those of a scrofulous nature, has now been fully proved. In bronchocele, friction with the ointment on the swelling may often be advantageously conjoined with the use of one of the preparations for internal exhibition.

In the *Archives Générales de Médecine* for July, 1823, Dr. Coster mentions the opportunity which he had had of remaining eight months at Geneva with Dr. Coindet, and of observing correctly the good effects of iodine in enlargements of the thyroid gland, and in scrofulous tumours. Dr. Coindet first of all employed this medicine under the form of alcoholic tincture, and obtained very surprising effects from its administration in goître. He next tried friction on the tumour itself, with an ointment, composed of the hydriodate of potass and lard; and the success of this practice was so great, that of nearly one hundred individuals affected with goître, whose cases Dr. Coster collected, more than two-thirds were completely cured by it. Soon after these successful results, iodine was employed, sometimes internally, and sometimes in the form of friction, in scrofula. "I shall not affirm (says Dr. Coster) that success was as uniform in the latter, as in the former disease; but it is certain, that scrofulous tumours yield sooner to the action of iodine than to that of any other remedy at present known: when the tumours, whether of the thyroid gland, or of the lymphatic glands, are hard and renitent, experience proves that the effects of iodine are much more prompt, when the frictions are preceded by the application of leeches, and a low regimen. Notwithstanding these precautions, however, the tumour sometimes continues stationary." In such a case, Dr. Coster put the tumour twice a day, for ten or twelve minutes, under the influence of the positive pole of the voltaic pile, taking care to change sides each time of using it: so that, in the morning, he made use of friction with iodine on the right side, and the action of the pile on the left; and, in the evening, applied the friction to the left side, and the galvanism to the right. In twenty days, not the least trace of the bronchocele was left. It is stated, that, in this instance, the voltaic pile, unassisted with the frictions of iodine was as ineffectual as the friction by itself had been. By the internal and external use of iodine, I once dispersed a bronchocele, which had formed in the neck of a young lady, aged about 12, who was brought to my house by my neighbour, Mr. Blair. The disease began to diminish in less than a week from the commencement of the treatment, and in six weeks the cure was complete. Since this, I have treated several other cases with an equally favourable result. An interesting case, in which a similar plan was attended with success, is recorded by Dr. Roots. (See *Med. Chir. Trans.* vol. xii. p. 310.) Another instance of its decided efficacy is reported by Dr. Barlow, of Bath (see *Edin. Med. Journ.* No. 79. p. 337.); but, whoever wishes to have a large and convincing body of evidence on this point, should consult the cases and observations published by Dr. Manson, of Nottingham, where bronchocele is said to be endemic. He gives the results of one hundred and twenty cases of bronchocele in which he administered iodine. Fifteen were in males, and one hundred and five in females. When the disease was complicated with diseased lymphatic glands, the thyroid gland first yielded, and then the others. In the fourth case, a scrofulous swelling of the foot yielded during the use of iodine. Of the hundred and twenty cases referred to, eighty-seven were cured, ten much relieved, and only two or three discharged without relief. (See *Manson* on *Medical Researche on the Effects of Iodine in Bronchocele, Paralysis, Chorea, Scrofula, Fistula Lacrymalis, Deafness, Dysphagia, White Swellings, and Distortions of the Spine*, Lond. 1825.) Some further notice of this gentleman's practice, as well as of the results of Mr. Buchanan's experience, will be taken in the articles, Ear, Iodine, Joints, Scrofula, Vertebræ, &c. For the preparations and doses of Iodine, see Iodine.

In South America a remedy for bronchocele, called *aceyte de sal*, was found, by M. Roulin, to contain a proportion of iodine. (See *Magendie, Journ. de Physiologie*, t. v p. 273.) The same gentleman has also proposed the trial of chlorine, or the free hydro-chloric acid.

Notwithstanding the numerous cures of bronchocele, accomplished by means of iodine, the plan fails in many instances As Dupuytren observes, the disease depends on different causes. Sometimes it is a simple hypertrophy; sometimes a schirrous degeneration; and, on other occasions, it is composed of cysts, filled with matter of different kinds. Iodine cannot answer equally for so many affections of diverse character. (*Clinique Chir.* t. iv. p. 467.) According to Dr. Sacchi, iodine is chiefly useful in the hypertrophic and scrofulous forms: less so in the lymphatic; and perfectly ineffectual against small isolated hard goîtres. The best mode of using iodine seems, to Dr. Sacchi, to be friction, with an ointment of hydriodate of potass, continued from one to several months.

Petit, Heister, and Schmucker make mention of inveterate bronchoceles, which gradually subsided, in consequence of suppuration. Volpi states, that such ulcerations are not unfrequent.

He has published two facts of this kind, which occurred after a nervous fever; and he records a third case, where the swelling inflamed in consequence of a blow, suppurated, and sloughed, so as entirely to disappear. (See *Léveillé, Nouvelle Doctrine Chir.* t. iv. p. 128.) A similar fact is recorded by Zipp. (*Siebold, Samml. Chir. Beob.* b. ii. p. 229.)

The disease, in its inveterate form, has also been sometimes removed by the application of caustic; (*Mesny in Journ. de Médicine,* t. xxiv. p. 75.; *Timæus, Cas.* p. 283.); the establishment of issues (*Jeitteles, Obs. Med.*); the making of an incision into the swelling, or the introduction of a seton through it. (*Foderé, Essai sur le Goître et le Cretinage,* p. 75.; *Klein, in v. Siebold, Sammlung Chir. Beobacht,* b. ii. p. 11.; *Flajani, Collezione d' Osservazioni di Chirurgia,* t. iii. p. 283.)

Bronchoceles have sometimes been removed by the part having been accidentally or purposely burnt to a considerable depth. (*Motte, in Blegny, Zodiac. ann.* 2. *Febr. Obs.* 11.; *Severinus de Efficaci Medicina,* p. 220.) The disappearance of bronchoceles has also been known to follow a wound. (*Schmidmüller über die Ausführungsgänge der Schilddruse,* p. 37, *Landshut,* 1805.) A. Burns sometimes employed blisters, and found them useful. (*Surgical Anatomy of the Head and Neck,* p. 204.) With respect to caustic, which is spoken of by Celsus (lib. 7. cap. 13.), Flajani states that its operation is tedious and painful, and attended with danger; and what he says about the practice of an incision is not more encouraging. When the disease contains a cyst, he prefers making an opening with a trocar, though he confesses that this plan is apt to be followed by a relapse, when the cyst is very thick and hard; in which circumstance it will be necessary to have recourse either to an incision, or the seton, for the purpose of exciting suppuration. Should the disease, however, be merely composed of one cyst of moderate size, Flajani recommends its entire removal. "Of all these methods (says he), proposed for the extirpation of bronchoceles, the seton is the least dangerous, and by means of it a radical cure may be generally effected without any severe symptoms, as I have found by experience in many cases. On the contrary, I have been an eye-witness of the fatal consequences induced by the other plans. I was called to assist a gentleman, about forty years of age, brought to death's door by a bleeding, which arose from the application of caustic to the fore part of the neck. As tourniquets, bandages, &c. proved quite ineffectual, it was indispensable to make pressure on the part with the finger of an assistant, for twenty-four hours, ere the hemorrhage could be stopped; a copious suppuration ensued; and it was three months before the parts were healed. I was likewise present (says he) at the opening of a similar, but larger swelling in the same situation, the disease having afflicted an elderly respectable patient for several years. The incision caused the evacuation of a small quantity of serum, contained in the cellular membrane, but the following day the tumour inflamed, the difficulty of respiration increased, and for some days the patient was in great danger. At length, suppuration was established, followed by a destruction of a great deal of the cellular membrane, and several sinuses, and, in five months, the patient lost his life. On examination of the body, the lungs were found tuberculated, an effect of the impediment to the circulation of the blood through the smaller vessels of those organs." (*Flajani, Collezione d' Osserv.* t. iii. p. 283. 8vo. Roma, 1802.)

The first proposer of the employment of setons for the cure of diseases of the thyroid gland, is perhaps not exactly known; but, it is certain, that the method has been known, and occasionally practised, ever since the middle of the last century. "Dr. Monro, senior (as a well-informed writer has observed), mentions in his lectures, that he has seen a dropsy in the centre of the gland, complicated with bronchocele, cured by a seton, although the glandular swelling still continued." (*A. Burns on the Surgical Anatomy of the Head and Neck,* p. 191.) This statement is given on the authority of some MS. notes taken by Dr. Brown from Dr. Monro's lectures. According to Girard, many cases in his time had been communicated to the Royal Academy of Surgery, at Paris, in which the disease was got rid of either by means of a seton, drawn through the swelling, or the application of an issue. (*Lupiologie,* &c. 8vo. Paris, 1775. (The occasional success of setons was also adverted to by Richter, in the year 1788. (*Bibliothek,* b. ix. p. 478.) And the plan is spoken of in another work, published in 1790, as being eligible, where the disease is conjoined with a cyst. (*Encyclopédie Méthod. Partie Chir.* t. i. p. 231.) The practice was particularly noticed by Foderé, in his valuable treatise on bronchocele; and Alibert mentions the seton as being used at the Hospital St. Louis. (*Nosol. Nat.* t. i. p. 466. fol. Paris, 1817.)

In November, 1817, Dr. Quadri, of Naples, tried this practice, which he erroneously supposed to be quite new. "By means of a trocar-pointed needle, six and a half inches long, I passed (says he) a seton from above downwards through the gland, at the depth of about four lines from its surface. Suppuration took place in forty-eight hours. On the 18th of November, the seton escaped, when the matter was squeezed out, and the irritation, occasioned by replacing it, produced an abscess on the right side of the neck, which was opened on the 23d, when it was found that the suppuration had affected the destruction of nearly the whole gland." The woman, who was thirty-six years of age, was seen by Dr. Somerville, in April, 1818, with the circumference of her neck lessened, from sixteen to thirteen inches French measure. In another case, referred to, a seton was passed through each side of the thyroid gland, and the result was the removal of the tumour on the side, where the seton had been maintained long enough; but, on the opposite side, the seton being withdrawn too early, the matter, collected in the sac, and at the end of four months, a sinus and discharge still continued, the patient refusing to have a counter opening practised. When the seton does not prove stimulating enough, Dr. Quadri sometimes enlarges it, or attaches to it escharotic, or irritating substances. He also frequently uses two setons. In one example, in endeavouring to perforate the gland rather deeply, Dr. Quadri appears to have injured the larger branches of the thyroid arteries, as more than an ounce of blood was discharged, and the tumour swelled, as if injected with blood. The bleeding, however, ceased spontaneously. He states, that the seton has been passed through the tumour not less than sixteen times, the direction being varied in every instance, without untoward accident; and he is confident, that, unless the needle be pushed deep enough almost to touch the thyroid cartilage, the trunks of the thyroid arteries will not be exposed to injury, while the branches, in the track of the needle, will not cause any danger. He insists also upon the propriety of retaining the seton in the tumour a considerable time; and observes, that it remains to be ascertained whether this practice will answer in every description of bronchocele. For these and several other cases and particulars, the profession is indebted to Dr. Somerville. (See *Med. Chir. Trans.* vol. x. p. 16 &c.)

Mr. Gunning applied a seton in a case of bronchocele in St. George's Hospital; but, in this instance, the irritation brought on sloughing, and the patient after a time died. The particulars of this case, and of three successful examples of the practice in England, have been lately recorded. One of the successful cases was treated by my friend, Mr. James, of Exeter, another by Mr. A. C. Hutchinson, who has taken the trouble to collect the history of them, and the third, by Dr. A. T. Thomson. (See *Med. Chir. Trans.* vol. xi. p. 235.) Percy and Dupuytren also employed setons in bronchocele with success. The plan, however, is sometimes inefficient, as is proved by two cases under Dr. Kennedy, of Glasgow. (See *London Medical Repository*, No. 99. Feb. 1822.) The exact nature of cases relieved by this practice, and their differenee from other examples, which are benefitted by treatment of a different kind, are still desiderata in surgery.

When a seton was passed through the thyroid gland, Dupuytren always noticed a copious discharge of venous blood; but, he found it soon stop, on desiring the patient to make full inspirations, and applying cold water, and moderate pressure. (See *Clinique Chir.* t. iv. p. 470.) Dupuytren would not have the seton looked upon as capable of curing every bronchocele. Of course, it will produce no favourable change in the scirrhous degeneration of the thyroid gland; but, in cases of hypertrophy, cysts, and hydatids, where iodine and other specifics frequently fail, the disease will be more likely to yield to the seton. (*Ib.* p. 471.)

The diseased thyroid gland has been successfully extirpated; but the operation is one of so much danger, that it ought never to be attempted, except under the most pressing circumstances. The many large arteries naturally distributed to the gland itself; their still greater size in bronchocele, and the vicinity of the carotid arteries, and important nerves, render the undertaking a thing of no common difficulty.

Mr. Gooch relates two cases, which do not encourage practitioners to have recourse to the excision of enlarged thyroid glands. In one, so copious an hemorrhage took place, that the surgeon, though equally bold and experienced, was obliged to stop in the middle of the operation. No means availed in entirely suppressing the bleeding, and the patient died in a few days. In the other, the same event nearly took place, the patient's life being saved only by compressing the wounded vessels with the hand, day and night, for a whole week, by persons who relieved each other in turn. This was found the only way of stopping the hemorrhage, after many fruitless attempts to tie the vessels.

Hemorrhage is not the only risk: Dupuytren removed a large bronchocele that caused dangerous pressure upon the trachea; the whole gland was taken away, and the four thyroid arteries and many veins secured. Only a few spoonfuls of blood were lost. The woman, however, died soon after the operation, with pale face, hurried respiration, cold skin, sickness, &c. denoting injury of some important nerves.

I do not mention these facts to deter surgeons from the operation altogether, because it is proved by modern experience, and especially by six cases in which Dr. Hedenus, of Dresden, has successfully removed the thyroid gland, that not only it is occasionally a necessary proceeding, but one that may be well accomplished by a skilful operator, as will be particularly explained in a future article. (See Thyroid Gland.) When bronchoceles by their pressure dangerously obstruct respiration, deglutition, and the return of blood from the head; and when the disease resists the efficacy of iodine, a seton, blisters, and every other plan of treatment found deserving of trial, what can be done with the view of saving the patient but the bold operation of cutting away the swelling, or that of exposing and tying one or both of the upper thyroid arteries?

When the quantity of blood flowing into a tumour is suddenly, and greatly, lessened, the size of the swelling commonly soon undergoes a considerable diminution. The experiment was once made by Sir W. Blizard: he tied the arteries of an enlarged thyroid gland, and in a week the tumour was reduced one-third in its size. The ligatures then sloughed off, repeated bleeding took place from the arteries, and, by the extension of hospital gangrene, the carotid itself was exposed. The patient died; yet, as Mr. A. Burns observes, this does not militate against a repetition of the experiment; as the same thing might have happened from merely opening a vein, and, in the confined air of an hospital, has actually happened. (*Surgical Anatomy of the Head and Neck*, p. 202.)

In fact, the rationality of the experiment prevented surgeons from being intimidated by the failure in question; and, with that laudable spirit for the improvement of operative surgery every where diffusing itself through the profession, other gentlemen were soon found who had judgment enough to make further trials of the practice. In a young man, twenty-four years of age, whose breathing was much impeded by a bronchocele, and whose upper thyroid arteries were very large and affected with strong pulsations, Walther of Landshut tied the left of these vessels, the left side of the gland being the largest. The operation was done on the 3d of June, 1814. An incision, an inch and a half in length, was made in the direction of the inner edge of the sterno-cleido-mastoid muscle, where the throbbing of the artery was quite distinct. By a second stroke of the knife, the platysma-myoides was divided in the same direction, and to an equal extent. The vessel was then exposed by a cautious dissection, and separated from the surrounding parts, and one arterial branch, which was divided, was immediately secured. A ligature, composed of three silk threads, was then conveyed with an aneurism-needle under the left thyroid artery, and tied with two simple knots. The wound was then closed with adhesive plaster, and the ends of the ligatures brought out at the angles. The ligature on the large artery came away on the 12th day; and, without any febrile symptoms or other bad consequences, the wound was perfectly healed on the 23d day. As early as the third day after the application of the ligature, the left part of the tumour began to be less tense, and the throbbing feel in it soon ceased. By degrees, it dwindled away, becoming, as it lessened, harder, and, as it were, cartilaginous. In a fortnight, the left half of the swelling was one-third smaller than before the operation; and, at length, only one-third of it remained, while the right side also was somewhat smaller. On the 17th of June, Walther took up the right superior thyroideal artery, which was more difficult to get at, as it lay more deeply, and was much concealed under the enlarged gland, which had pushed it out of its natural situation. The operation lasted three-quarters of an hour; and several large and small arteries which were cut were tied. With respect to the thyroid artery itself, it could not be tied without including a part of the gland in the ligature. No unfavourable symptoms followed this second operation; the ligatures were detached in good time, and the wound healed up very well. The right portion of the bronchocele also now diminished; but, though it was originally smaller than the left, it did not dwindle away so completely as the latter. The remains of the tumour, however, two years afterwards, produced no inconvenience, and respiration was quite easy. (See *Neue Heilart der Kropfes, &c. von Ph. Fr. von Walther*, p. 25, &c. 8vo. Sulzbach. 1817.) On the 29th of December, 1818, Mr. H. Coates, of Salisbury, took up the superior thyroideal artery for the cure of a bronchocele, which, in a young woman, aged seventeen, made pressure on the trachea and œsaphagus, attended with a great noise in breathing. The superior thyroideal arteries were in this instance large, and pulsated strongly. Mr. Coates cut down upon the left of these vessels, separated it from its accompanying nerve, and passed under it a small round ligature, which was drawn moderately tight, and tied. The next day, there was headach, and some swelling of the neck and side of the head, with increased difficulty of swallowing, and febrile symptoms. These complaints, however, were relieved by bleeding and antimonial medicines. The ligature came away on the 9th day; and, on the 14th, the wound was completely healed. On the 14th of February, the breathing being much improved, and the tumour reduced nearly to one-half of its former size, the patient was well enough to be discharged from the infirmary. (See *Med. Chir. Trans.* vol. x. p. 312.) The late Mr. Rose once mentioned to me a case, in which a similar operation, done by Sir Benjamin Brodie, did not produce any material diminution of the tumour.

Two successful cases of ligature of the superior thyroid artery are recorded by Chelius. (See *J. G. Crosse in Provincial Med. Chir. Trans.* vol. v.)

Dr. Parry remarked a frequent coincidence either as cause or effect, between enlargement of the thyroid gland, and cardiac diseases. (*Elements of Pathology, &c.* p. 181.) And another modern writer mentions, that he has lately seen three cases of this complication. (*Medico Chir. Journ.* vol. i. p. 181.) A case is detailed by Flajani, where the disease was accompanied with extraordinary palpitations of the heart. (See *Collezione d'Osservazioni, &c. di Chirurgia*, t. iii. p. 270.) In the instance here referred to, there was great irregularity of the pulse; and the oppression of the breathing was such, that the patient was obliged to submit to venesection at least every month, whereby he was rendered quite emaciated.

Albucasis gave the first good account of Bronchocele. *Wilmer*'s Cases and Remarks in Surgery, with an Appendix on the Method of Curing the Bronchocele in Coventry, 8vo. Lond. 1779. *Prosser*, An Account and Method of Cure of Bronchocele, or Derby-neck, 8vo. Lond. 1769.; also, 3rd edit. 4to. Lond. 1782. Memoirs of the Med. Society of London, vol. i. *Gooch*'s Chirurgical Works, vol. ii. p. 96.; vol. iii. p. 157. *Desault*'s Parisian Chirurgical Journal, vol. ii. p. 292. Œuvres Chirurgicales de *Desault*, par *Bichat*, t. ii. p. 298. *V. Malacarne*, Lettre sur l'Etat de Cretin: (Frank. Del. Op.) Edin. Med. and Surgical Journal, vol. iv. p. 279. *Odier*'s Manuel de Médecine Pratique, 8vo. Genève, 1811. *Dr. Reeves*'s Paper on Cretinism, in Edin. Med. and Surg. Journal, vol. v. Traité du Goître, et du Cretinisme, par *F. E. Foderé*, 8vo. Paris, an. 8. *Richter*'s Anfangsgründe der Wundarzneykunst, b. iv. kap. 13. von Kropfe. Surgical Anatomy of the Head and Neck, by *A. Burns*, p. 191, &c. *Larrey*, Mémoires de Chirurgie Militaire, tom. i. p. 123.; t. iii. p. 199, &c. *J. F. Ackermann*, üeber die Kretinen, eine besondere Menschenabart in den Alpen. 8vo. Gotha, 1790. *B. S. Barton*, A Memoir concerning the Disease of Goître, as it prevails in different parts of North America, 8vo. Philadelphia, 1800. Memoria Patologico-Practica sulla Natura di Gozzo, &c. del Dottor Prospero Postiglione, 12mo. Firenze, 1811. *Kortum.* Comment. de Vitio Scrofuloso, t. ii. *Giuseppe Flajani*, Collezione d' Osservazioni e Riflessioni di Chirurgia, t. iii. p. 270, &c. 8vo. Roma, 1802. *Quadri*, in Med. Chir. Trans. vol. x. p. 16. Dict. des Sciences Méd., art. Bronchocele. *Ph. Fr. Walther*, Neue Heilart des Kropfes durch die Unterbindung der obern Schildrusen Schlagadern nebst der Geschichte eines durch die Operation geheilten Aneurismâs der Carotis, 8vo. Sulzbach, 1817. *H. Coates*, in Med. Chir. Trans. vol. x. p. 312, &c. *Gautieri Tyroliensium*, Carynthiorum, Styriorumque Struma; Viennæ, 1794. *Maas*, Diss. de Glandula Thyroidea tam Sana quam Morbosa, &c. Wireeb. 1810. *Hausleutner*, üeber Erkenntniss, &c. des Kropfes, in *Horn*'s Archiv. b. xiii. 1813. *Mühlibach der Kropf.* nach seiner Ursache, Vehütung, und Heilung. Wien. 1822. *Hedenus*, Tractatus de Glandula Thyroidea, &c. Lips. 1822. *Lassus*, Pathologie Chirurg. t. i. p. 408, &c. *Petit*, Œuvres Posthumes, t. i. p. 255. *Haller*, Opuscula Pathologica, Obs. v. p. 16. *J. L. Alibert*, Nosologie Naturelle, t. i. p. 464, &c. fol. Paris, 1817. *A. C. Hutchison*, Cases of Bronchocele, or Goître, treated by Seton: Med. Chir. Trans. vol. xi. p. 235, &c. *A. de Humboldt*, Observations sur quelques Phénomènes peu connus qu' offre le Goître sous les Tropiques, dans les Plaines et sur les Plateaux des Andes; in Journ. de Physiologie par *F. Magendie*, t. iv. p. 109, 8vo. Paris, 1824. Observations on the remarkable Effects of Iodine in Bronchocele and Srofula; being a translation of three Memoirs published by *J. R. Coindet, M.D.* Lond. 1821. *J. C. Straub*, in Naturwissenschaftlicher Anzeiger der Allgemeiner Schweizerischer Gesellschaft, &c. herausgegeben von *Fr. Meisner*, 4to. Bern. Feb. 1820. *Brera*, Saggio Clinico sull' Iodio, &c. Padova, 1822. *W. Gairdner, M.D.*, Essay on the Effects of Iodine, with Practical Observations on its use in Bronchocele, Scrofula, &c. Lond. 1824. *H. S. Roots*, in Med. Chir. Trans. vol. xii. p. 310. *Coster*, in Archives Générales de Médecine, Juillet, 1823. *J. Kennedy*, in London Med. Repository for Feb. 1822. *Dr. A. Manson*, Medical Researches on the Effects of Iodine in Bronchocele, &c. Lond. 1825. *M. Roulin*, Note sur quelques Faits relatifs à l'Histoire des Goîtres; in Magendie's Journ. de Physiologie Expér. t. v. p. 266. *J. A. W. Hedenus*, Ausrottung der Schildrüse, in Journ. der Chir. von *C. F. Graefe* und *Ph. Von Walther*, b. ii. p. 237, &c. or Journ. of Foreign Medicine, vol. v. p. 317, &c. *Sacchi*, Annali Universali, Dec. 1832. *Dupuytren*, Leçons Orales de Clinique Chir. t. iv. p. 464. Paris, 1834. For the best plates of the disease, see *Dr. Baillie*'s Series of Engravings, &c. fasc. ii. tab. 1.

BRONCHOTOMY, (from βρόγχος, the windpipe, and τέμνω, to cut.) An operation by which an opening is made into the trachea, either for the purpose of making a passage for the air into and out of the lungs, when any disease prevents the patient from breathing through the mouth and nostrils, or of extracting foreign bodies, which have accidentally fallen into the trachea: or, lastly, in order to be able to inflate the lungs in cases of suspended animation. The operation is also named *tracheotomy.* When the incision is made in the larynx, the operation is termed *laryngotomy.* (See Laryngotomy and Tracheotomy.)

BUBO, (βουϐὼν, the groin.) A swelling of the lymphatic glands, particularly of those in the groin, from acute or chronic inflammation, with or without suppuration. The term is also occasionally applied to a similar swelling of the absorbent glands in other parts, especially the axilla.

The disease may arise from the mere irritation of a local disorder, from the absorption of some irritating matter, such as the venereal poison, or from constitutional causes.

Of the first kind of bubo, that which is named the *sympathetic* is an instance. Of the second, the venereal bubo is a remarkable specimen. (See Venereal Disease.)

The *pestilential bubo,* which is a symptom of the plague, and *scrofulous* swellings of the inguinal and axillary glands, may be regarded as examples of buboes from constitutional causes. (See Scrofula.)

The inguinal glands often become affected with simple phlegmonous inflammation, in consequence of irritation in parts, from which the absorbent vessels, passing to such glands, proceed. These swellings ought to be carefully discriminated from others, which arise from the absorption of venereal matter. The first cases are simple inflammations, and only demand the application of leeches, cold evaporating lotions, and the exhibition of a few saline purges; but the latter render the administration of mercury, or other remedies for syphilis, advisable.

Sympathetic is the epithet usually given to inflammation of glands from mere irritation; and we shall adopt it without entering into the question of its propriety.

The sympathetic bubo is mostly occasioned by the irritation of a virulent gonorrhœa. The pain, which such a swelling gives, is trifling, compared with that of a true venereal bubo, arising from the absorption of matter, and the tumour less frequently suppurates. However, it has been contended, that the glands in the groin do sometimes swell and inflame from the actual absorption of venereal matter from the urethra, in cases of gonorrhœa, and, if this were true, the swellings would be venereal; but the doctrine is now nearly exploded. (*Hunter on the Venereal,* p. 57.)

BUBONOCELE, (from βουϐὼν, the groin, and κήλη, a tumour.) A species of hernia, in which the bowels protrude at the abdominal ring. The case is often called an *inguinal hernia,* of which there are varieties. (See Hernia.)

BUNYON. An inflammation of the bursa mucosa, at the inside of the ball of the great toe. (See *Brodie's Pathalogical and Surgical Obs. on the Joints,* p. 320. ed. 3.) The adjacent parts become thickened and indurated; the bones of the joint enlarge, and in process of time suffer a sort of subluxation; the bursa being thus projected more and more against the shoe, is kept in a state of continual excitement. Dropsical effusion, thickening of the membrane, and suppuration, with obstinate sinuses, may ensue. (See *Symes's Princ. of Surgery,* p. 347.) It is therefore proper to employ, in the early stage of the inflammation, leeches, poultices, and fomentations, or cold applications, and in particular to remove pressure from the swollen part, the foot being kept perfectly quiet, and not in a depending position. I suspect that the subluxation, or projection of the bones inwards at the joint above spoken of, is frequently antecedent to the bunyon, and a principal cause of the disease. I had a patient in the North London Hospital, with an enormous bunyon, and in whom the original conformation of the toe of each foot corresponded to this statement. In fact, he suffered from bunyons in both feet, in consequence of the pressure acting with great effect on the angular projection at the inner side of each of the great toes. I have no doubt, however, that the inflammation and its effects may lead to disease and further displacement of the joint; and perhaps this had happened in the case to which I am referring.

BURNS. A burn is the effect of the action of concentrated heat on the living textures; and it is upon the nature of its cause that its peculiar characters depend, which prevent it from being confounded with any other kind of injury. These characters, seemed to Dupuytren to partake at once of the nature of inflammation, of that of wounds, and of disorganisation. (*Clin. Chir.* t. i. p. 417.) This view does not seem to me strictly correct, unless a chemical injury can be rightly called a wound, and every burn without exception, is essentially accompanied by disorganisation, which is well known not to be the fact, according to the usual import of that term amongst British pathologists.

Dupuytren, indeed, concurs with all surgical writers in representing the effects of the action of caloric, as attended with great diversity in respect to their intensity and severity, according as they may have been produced by radiating heat at variable distances, or by the direct action of flames emitted by the combustion of various substances; or by the direct application of the ignited bodies themselves.

Moderate, but long-continued, radiating heat thickens the cuticle, hardens the skin, blunts its sensibility, and renders it more or less brown. These effects are exemplified in persons habitually exposed to the burning rays of the sun, or whose usual occupations are before vast fires. Thus, as Dupuytren observes, smiths are able to grasp with their rough horny hands pieces of iron of a very high temperature, and even to touch them for a few seconds with impunity.

A higher degree of radiating heat produces marbled discolorations in the skin, and cracks in the cuticle, frequently leading to troublesome ulcerations. Such effects are common on the shins of old persons, who are constantly sitting close to the fire. In a still greater intensity, radiating heat will blister the surface of the body, or cause the formation of vesicles. In hot climates, exposure to the solar rays during sleep is alleged sometimes to have excited inflammation, followed by gangrene, and death on the fourth or fifth day. (See *Dupuytren, Clin. Chir.* t. i. p. 419.)

As for flame, it is described by Dupuytren, not only as occasioning an instantaneous burn, like heated substances directly applied to parts, but also as readily drawing animal substances into a participation in the movement of combustion, of which it is itself the product. The animal textures subjected to its action rapidly part with their moisture, become shrivelled and bent, or twisted, and emit a flame, which annexing itself to the first, increases its activity and its ravages.

The great depth and fatality of burns produced by the clothes or dress taking fire, are familiarly known to all surgeons; and instances have occurred in which the bodies of individuals in a state of intoxication, or apoplexy, have been entirely consumed in a few hours. The same thing has happened to infants, incapable of extricating themselves from the flames. Dupuytren arranges with burns produced by flame, those caused by the combustion of hydrogen gas, and by the explosion of gunpowder. In general, gases cause only superficial, but at the same time very extensive burns, because they act instantly upon large surfaces. Burns of this description, however, sometimes penetrate through the cutis. The degree of a burn is according to the nature and density of the ignited or heated substances which are immediately applied to the living textures, their capacity for caloric, and the facility with which they relinquish it. Thus, all boiling fluids do not burn with the same force, because they do not all boil at the same temperature. Hence, the burning action of fatty substances, as soup, oil, lard, &c. is more energetic than that of water. But as Dupuytren justly adds, another cause of this difference depends upon the former adhering to the skin, while water merely runs over it. Solid bodies, when their combustion is rapid, like that of phosphorus, sulphur, and resinous substances in general, occasion deep burns. In the contrary case, the intensity of their effects is determined by their degree of heat, the duration of their application, and the tissues being more or less susceptible of the impression. Cæteris paribus, a burn is less deep when it takes place on parts habitually exposed to the air, than when it occurs on parts always covered with clothes, and whose cuticle is very thin. (See *Dupuytren Clin. Chir.* t. i. p. 420—422.)

In all burns, then, the quantity of injury depends on the degree of heat in the burning substance, on the duration and extent of its application, and on the sensibility of the burnt parts.

By Fabricius Hildanus, Boyer, and Dr. J. Thomson, burns are divided into several kinds or degrees:—1st. Into such as produce an inflammation of the cutaneous texture, but an inflammation which, if it be not improperly treated, almost always manifests a tendency to resolution. 2dly. Into those which occasion the separation of the cuticle, and produce suppuration on the surface of the skin. 3dly. Into others, in which the vitality and organisation of a greater or less portion of the cutis are either immediately or subsequently destroyed, and a soft slough or hard eschar is produced. (See *Thomson on Inflammation*, p. 585, 586.)

Suppuration is not always an unavoidable consequence of vesifications in burns; but it is a common and a troublesome one. "In severe cases, it may take place by the second, or third day; often not till a later period. It often occurs without any appearance of ulceration, continues for a longer or shorter time, and is at last stopped by the formation of a new cuticle. In other instances, small ulcerations appear on the surface or edges of the burn. These, spreading, form extensive sores, which are in general long in healing, even where the granulations which form upon them have a healthy appearance." (*Op.* cit. p. 595.)

Heister and Callisen divide burns into four degrees, by adding to the preceding those which occasion, not merely suppuration on the surface of the cutis, but ulceration not necessarily accompanied or preceded by sloughing.

As Dupuytren observes in the above-mentioned classification of burns, attention is paid only to the intensity of the effects of the burn, considered generally, while the nature of the organs which are the seat of them, the textures affected or destroyed, are entirely disregarded. Yet, it is manifest that heat acts first upon the skin, and that then its effects extend to variable and successively increasing depths. Dupuytren therefore preferred another classification, in which burns are divided into six degrees:—1. Erythema, or superficial phlogosis of the skin, without vesicles. 2. Inflammation of the skin, with detachment of the cuticle, and the formation of vesicles, filled with serosity. 3. Destruction of a part of the corpus papillare, and rete mucosum. 4. Disorganisation of the cutis completely down to the subcutaneous cellular tissue. 5. Conversion of all the superficial textures and the muscles into eschars to within a variable distance from the bones. 6. Carbonisation of the whole thickness of the burnt part.

In the first degree of a burn, the parts are of a bright red colour, which is uncircumscribed, and like that of erysipelas, disappears for a moment after pressure with the finger, and the injury is attended with sharp pain. Frequently in a few hours, and always within a few days, the redness, heat, and pain cease, and the case terminates in desquamation, or a peeling off of the cuticle. However slight this degree of a burn may be, it is not unusual, when an extensive surface is implicated, for the pulse to rise and be accelerated, the tongue to be reddened, and symptoms of gastro-intestinal irritation to come on. When the head is the seat of the burn, the irritation is liable to be propagated to the brain, and then restlessness, delirium, convulsive twitches, coma, and even death may ensue. (*Dupuytren, Clin. Chir.* t. i. p. 424.)

The second degree of a burn is always owing to the action of more intense heat, or the longer continuance of its application. A sharp burning pain is felt, and sometimes at the same moment, but more frequently at the expiration of a few hours, one, or several vesicles, filled with a clear transparent serosity, are formed upon the burnt surface. The pain is then accompanied by a sense of tension. The vesicles either burst or are pricked; the detached cuticle dries, and, in a few days, falls off in large pieces, or peels off in smaller ones, leaving the subjacent rete mucosum covered with new cuticle; yet reddish, thin, and delicate. Sometimes, (to continue Dupuytren's admirable description) the cuticle, instead of forming vesicles, is torn in the first instance from the rete mucosum, which remains exposed. Most severe pain is the consequence of this incident, which is always followed by slight suppuration. But, at length, the denuded surface becomes dry, and soon merely a redness is left, which disappears, without leaving any vestige of the injury behind.

Dupuytren's third degree of burn essentially consists of a causterisation of the rete mucosum and of the papillary surface of the cutis. It is denoted by grey, yellow, or brown spots, which are thin, supple, and insensible, if gently touched, but more or less painful if greater pressure be made on them. The vesicles, frequently arising over the points disorganised, in this degree, ordinarily contain a brownish milky serosity, or else a serosity highly tinged with blood; and this appearance is, at the very first, useful in the diagnosis. In these cases, sometimes the eschar is thrown off in a mass at the ordinary period; and, on other occasions, it falls off in fragments, so as to bring into view, in the places covered by the phlyctenæ, more or less extensive but superficial ulcerations, the cicatrices of which, though not complicated with cord-like fræna, will almost always remain conspicuous, on account of the white, dense, shining substance formed as a substitute for the destroyed surface of the cutaneous texture. To this degree belong the majority of burns caused by gunpowder, and the eschars of which are blackened by the materials of which it is composed.

In whatever shape a burn of this degree may at first present itself, the pains, which had subsided at the end of 24 or 48 hours, return acutely; a preliminary inflammation occurs; the eschar becomes circumscribed, loosened, and detached; and the whole soon heals, leaving a scar of a dead white colour. (See *Dupuytren, Clin. Chir.* t. i. p. 426.)

This celebrated surgeon lays it down as a principle, that, though the pain of all burns is acute, it is more intense, when only the surface of the skin is burnt than when this texture is deeply destroyed; a fact of great importance, in relation to the prognosis.

The following are the characters of a burn of the fourth degree, as described by Dupuytren. When an ignited substance is applied to the part for a considerable time, a sharp pain is the effect, but, this ceases as soon as the cause of the burn is removed. The cuticle, rete mucosum *, the whole thickness of the skin, and sometimes also a superficial layer of the subcutaneous cellular tissue, are struck by death, and converted into a deep, yellowish, or blackish, dry mass, which is not at all sensible when touched, and harder and tenser in proportion as its colour is darker. The adjoining sound skin is wrinkled and pinched up, as it were; the radiating folds around the burnt part denoting the degree of shrivelling which this has undergone. In three or four days, the pain returns, and an inflammatory circle forms around the slough, which is generally loosened between the fifteenth and twentieth days. The bottom of the ulcer corresponds to the subcutaneous cellular tissue; the suppuration is very copious; and granulations rise up with vigour.

Burns of the fifth degree only differ from the preceding, by extending to parts more deeply situated, and they are liable to be followed by extremely alarming consequences. The eschars, which comprise aponeuroses, muscles, and tendons, and in the substance of which sometimes vessels and nerves are placed, which have resisted the action of the fire, are sonorous, black, brittle, and depressed, and require a much longer time for their detachment. When they are soft, or occasioned by boiling fluids, they present a grayish, insensible mass, which sinks under the finger, without any pain being excited. Suppuration is still more profuse, and the cicatrix, involving the muscles themselves, remains mis-shaped, and adherent, and the power of motion in the part is irremediably lost.

In Dupuytren's sixth degree of a burn, the whole thickness of the injured part is involved, and its surface is as black as charcoal, hard, sensible, sonorous when struck, and readily broken by any efforts made to bend it, and, after the detachment of the eschars, a more or less irregular stump is left. (See *Dupuytren* in *Clin. Chir.* t. i. p. 428—431.)

Burns then present different appearances, according to the degree of violence with which the causes producing them have operated, and according to the kind of cause of which they are the effect. Burns which only irritate the surface of the skin are essentially different from those which destroy it; and these latter have a very different aspect from what others present, which have attacked parts more deeply situated, such as the muscles, tendons, ligaments, &c. Scalds which are the effect of heated fluids do not exactly resemble burns occasioned by the direct contact of hot metallic bodies, or a combustible substance on fire. As fluids are not capable of acquiring so high a temperature as many solids, scalds are generally less violent than burns in the injury which they produce; but, in consequence of liquids often flowing about with great rapidity, and being suddenly thrown in large quantities over the patient, scalds are frequently dangerous on account of their extent. The danger of a burn is not less proportionate to the size, than the degree and depth of the injury. A burn that is so violent as to kill parts at once, may not be in the least dangerous if not extensive; while a scald, which perhaps only reddens the skin, and raises the cuticle, may prove fatal if very large. The worst burns arise from explosions of gunpowder, or inflammable gases, from ladies' dresses catching fire, and from the boiling over of hot fluids in laboratories, manufactories, &c.

In the slighter degrees of burns, vesicles form; but when the skin is at once destroyed, no vesicles make their appearance over the eschar. In some burns, the parts are killed at the moment of the injury; in others, they first inflame, and then mortify.

The extent of mischief it is often difficult to judge of, directly after the accident, notwithstanding the characters of the various degrees of organic injury are strongly marked; for, at the same time that the heat disorganises the parts on which it acts with the greatest violence, it always affects the textures immediately below them; and though they may not be killed in the first instance, they may not be capable of bearing the subsequent inflammation, and afterwards mortify. Hence, as Dupuytren has remarked (*Clin. Chir.* t. i. p. 433.), the greater number of burns appear deeper and more extensive after the separation of the eschars than at first suspected; and the knowledge of this fact is of great importance in medical jurisprudence, with reference to burns of the third, and other severe degrees, inasmuch as the surgeon is cautioned by it not to pronounce an opinion concerning the degree of danger, until the sloughs have begun to loosen, and the extent of mischief to be settled.

In the various cases, the phenomena, peculiar to each degree, are not exclusively those which present themselves. In general, the effects of the different degrees of injury are blended together in the same burn. Thus, as Dupuytren observes, from the point, where the eschar is deepest, where it may even reach down to the bones, and involve the whole thickness of a part, it becomes gradually superficial, until at length it comprehends only the rete mucosum and cuticle.

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* *Le corps muqueux*, as Dupuytren calls the rete mucosum, is regarded by Breschet and others merely as an inorganic secretion.

The principal eschars are frequently surrounded by more superficial ones; and often between the disorganised parts, or in their vicinity, there are only vesicles of different sizes, and again, beyond these, or, in the interspaces between the places of deepest mischief, there may be simply erythematous redness. Lastly, in many cases, all the several degrees of burn are exemplified in the different regions of the body.

Burns, according as they are of little or considerable extent, may be regarded either as purely local affections, or as injuries productive of such constitutional disturbance as may endanger life itself. The effects on the system at large may be the immediate result of a general shock, or, (as Dupuytren terms it) irritation, caused by the action of caloric: or, they may be secondary, coming on during the stages of inflammatory reaction, suppuration, and hectic exhaustion, which often succeed one another in the progress of the case. Hence, the division of the constitutional symptoms into primary, and consecutive. (See *Dupuytren, Clin. Chir.* t. i. p. 434.)

The mere sufferings, immediately occasioned by a burn, may prove instantaneously fatal, death taking place from excessive pain; at least such is the explanation of the fact given by Dupuytren, which, however, it is rather difficult to reconcile with his subsequent observation, that, in such cases, there is congestion of nearly every organ in the great cavities, which congestion, in relation to some important organs, especially the brain, one would expect, ought to have a share in occasioning the patient's death. Be this as it may, he found that the sudden fatality of burns was chiefly exemplified in children and nervous females, more rarely in adults, and still less frequently in old persons.

Supposing death, however, not to be produced thus suddenly, then excessive agitation, restlessness, spasms, convulsions, and intense fever sometimes ensue; while, in other instances, the patients sink into a state of stupor and prostration, the pulse being small and rapid; the skin cold and pale in parts of the body not touched by the fire; respiration slow; the limbs motionless and abandoned to their own weight; and questions unanswered, or replied to reluctantly and imperfectly. This kind of collapse may soon terminate either in death, or in a general reaction.

If the burn is superficial, and does not exceed the second degree; if it is of moderate extent; and especially if the constitution is peculiarly irritable, the formidable symptoms above specified are not observed, but a general reaction takes place, similar to what happens in erysipelas. The pulse becomes frequent and strong, the skin hot, the tongue dry and red, denoting irritation of the digestive organs, and there is thirst, nausea, or vomiting, loss of appetite, &c. In numerous cases of deep burns, amounting to the third and fourth degrees, no remarkable symptom occurs in the interval between the period of the accident and the time when the process for the detachment of the eschars commences. But at this crisis, which is usually about the fourth day, the inflammation excites pain, which is very acute when the burn happens to be in parts where the cutis is largely supplied with bloodvessels and nerves. When extensive surfaces are injured, all the above-mentioned symptoms of nervous and gastric irritation, which take place in a burn of the second degree, may present themselves, but in a far more intense form, and sometimes with such severity, that they quickly prove fatal. (See *Dupuytren*, in *Clin. Chir.* t. i. p. 434—436.)

It has long been observed, that persons, who die of severe burns, experience a remarkable difficulty of breathing, and oppression of the lungs. The common explanation of this fact was, that, as these organs and the skin are both concerned in separating a large quantity of water from the circulation, their participating in this function would account for respiration being often much affected, when a large extent of skin is burnt. However, the kidneys perform the same office, and they are not particularly affected in burnt patients; so that the asthmatic symptoms, frequently noticed in cases of burns, are probably owing to some other cause. Dupuytren attributes them in the first instance to the impression made on the organs of the circulation and respiration, and then to the secondary developement of intense bronchial irritation, or considerable pulmonary congestion.

If the patients have surmounted all the foregoing perils, others still await them; for, as Dupuytren observes, whenever burns are deep and extensive, and consequently leave, after the separation of the sloughs, ulcers of great size, the copiousness and long continuance of the suppuration frequently exhaust the strength, and by degrees bring on great emaciation. In burns, this stage of suppuration and exhaustion is characterised by the same symptoms, as accompany the latter stages of all chronic diseases.

Amongst the severe complications of burns, Dupuytren enumerates erysipelas, particularly phlegmonous erysipelas, which, if not checked, leads to gangrene of the cellular tissue, the production of large abscesses and sinuses, an extensively undermined state of the integuments, and excessively profuse suppuration; circumstances, in which the amputation of the limb, now the only means of preserving life, offers but a doubtful chance of success.

According to the doctrines of Dupuytren, there are then four different periods or stages, in which the patient's life may be successively endangered in cases of severe burns:—

1. The stage of irritation, or, as I should say, the period of the first shock on the system.
2. The stage of inflammation.
3. The stage of suppuration.
4. The stage of exhaustion, or hectic. (See *Clin. Chir.* t. i. p. 438, 439.)

The *post mortem* examinations of burnt patients, instituted by Dupuytren, tend to prove that, when the sufferer perishes in the flames, or a few instants after having been extricated from them, traces of excessive congestion are observable in the digestive tube, although there has not been sufficient time for inflammation to commence. Not only does the mucous membrane exhibit bright red patches of greater or less size—not only is it gorged with blood, but the cavity of the intestines contains a certain quantity of this fluid, which has passed into it by exhalation. The brain is largely injected with blood, and the serosity in its ventricles of a reddish tint, which is likewise frequently noticed in the serous fluid of the pericardium, pleura, and peritoneum. The mucous secretion of the bronchi is also bloody, and their investing membrane, at various points, of a bright red colour, and streaked with highly injected capillary vessels. It seems, in such cases, as if the blood, suddenly driven from the skin, made an effort to escape through all the pores of internal surfaces. (*Clin. Chir.* t. i. p. 440.) A boy, about fifteen years old, died in the North London Hospital in the winter of 1835-36, a few hours after the receipt of an extensive and deep burn. I took the opportunity of having the body carefully examined, in the expectation of finding the congestions of the mucous surfaces, and the bloody serosity in the ventricles of the brain, the chest, &c. specified by Dupuytren; but these effects were much less conspicuous than the observations of this distinguished surgeon led me and others to anticipate.

According to Dupuytren when patients die between the third and eighth days after the accident, or in the second stage, in consequence of the violence of the inflammatory action all the signs of gastro-enteritis will be found strongly marked, and ordinarily accompanied by inflammatory affections of the brain and lungs.

Lastly, if the patient has not sunk till a later period, or the stage of suppuration and exhaustion, the viscera, especially the intestines, are found much altered by the previous long-existing inflammation; the mucous coat is studded with patches of redness, and ulceration, and the mesenteric glands are generally enlarged. (Also *Andral, Anat. Pathol.* t. ii. p. 223.)

In a child, three years old, who died in November, 1836, under my care in the North London Hospital, about a month after her admission with several extensive burns of the fourth and fifth degrees, the *post mortem* examination revealed inflammation of the mucous membrane of the bowels in various places, and deposits of pus in the lungs.

The prognosis in burns is to be deduced from their extent, depth, and situation; the nature of the cause which has occasioned them; and the age and constitution of the patient. Strong, sanguineous, young subjects are more exposed than others to such bad symptoms as may originate from excessive inflammation. (*Dupuytren, Clin. Chir.* t. i. p. 442.) Burns of the head and trunk are more perilous than those of the limbs. Vesicles, redness, and burns of the third degree leave behind either no traces of them, or none which are very conspicuous. But burns of the fourth degree, which involve the whole thickness of the skin, if not properly treated, will give rise to deformed cicatrices, and disadvantageous adhesions, especially when the eyelids, face, neck, hands, or feet, are amongst the injured parts. The reason of this is correctly ascribed by Dupuytren to the tendency of all ulcers in the integuments, and more particularly of such as result from burns, to contract, and diminish by the approximation of their margins to the central point. Thus, the fingers may be drawn towards the back of the carpus and confounded with it; the whole hand fixed against the forearm; the radio-carpal articulation dislocated (see *Cruveilhier, Anat. Pathol. Livr.* ix.); the foot variously twisted and constituting only a shapeless mass; the head forcibly drawn to the shoulders; the nape of the neck adherent to the back; the chin to the sternum; the ears to the adjacent portion of the scalp, &c.

In a burn of the fifth degree, the destruction of tendons and muscles deprives the limb of the power of executing its functions; the thickness of the disorganised tissues is followed by so copious a suppuration, that the patient is in danger of falling a victim to debility; and the exposure of the bones creates a risk of necrosis. A burn of this description may open the synovial membranes, and excite inflammation in them; and if the joint implicated be of considerable size, the most favourable issue can only be looked for in anchylosis or amputation. (See *Dupuytren, Clin. Chir.* t. i. p. 443, 444.)

In the limbs, a burn of the sixth degree renders amputation indispensable.

A burn of the first degree, if very extensive, often proves fatal immediately, or in a few hours after the accident. But, after 24 or 48 hours, resolution begins, and the danger is over. The same observations apply to a burn of the second degree; but it is attended with a greater chance of inflammation of internal organs, the tendency to which continues also for a longer time. In burns of the third degree, the patients are exposed not only to all the dangers accompanying burns of the two first degrees, but to others arising during the inflammation preliminary to the loosening of the eschars: first, to speedy death from the irritation, or shock on the system; to an immediate attack of gastro-enteritis; or of tetanus, spasms, and convulsions; or, in a later stage, to the same consequences. When such a burn is so extensive, as to affect two or three square feet of the skin, it generally proves fatal in the stage of detachment of the eschars, or that of suppuration. In a burn of the fourth degree, and above it, the pain and irritation only continue while the cause is operating; but the patients may perish immediately. If they yet live, sometimes they are plunged in a complete stupor; are seized with an icy coldness, and die in a few hours; while, in other instances, the system rallies, but the patients are cut off by the inflammatory reaction between the fifth and ninth day. Lastly, sometimes they are worn out and destroyed by the profuseness of the suppuration, the length of the disease, or an attack of hospital gangrene, or fever of bad type. Burns of the fifth degree, even though not very extensive, are unavoidably productive of considerable danger, on account of the inflammatory reaction, or febrile disturbance, which must ensue; and the danger is often very much augmented, by almost all the degrees of burns, which are usually noticed in the neighbourhood of a burn of the fifth degree.

Burns, implicating the conjunctiva, may cause ophthalmy and opacity of the cornea; or, if their effects reach more deeply, they may occasion a total disorganisation of the eye. (See *Op. et.* vol. cit. p. 447—450.)

Treatment of Burns.

In all ages burns have been objects of empiricism. Sovereign and specific remedies for them have been tried and lauded one after another in endless succession, each falling into oblivion to be succeeded by others of the same temporary and undeserved reputation. It seems as if nothing would ever open the eyes of those, who search after infallible remedies for these peculiar injuries. The fact, that a burn presents itself in very different states and degrees, and that it is generally a complicated kind of injury, ought at once to render it plain to the most common understanding, that the various conditions and complications of burns must necessarily require great diversity in the treatment; which, as Dupuytren has explained, should be founded upon the following indications: — 1. That of keeping down inflammation; and, in the two first degrees of a burn, assuaging pain and irritation, and preventing the extension of effects to internal organs. 2. That of keeping within proper bounds the secondary inflammation, attending the separation of eschars, and the establishment of suppuration. 3. That of promoting the healing of the ulcers. 4. That of resisting the formation of fræna and adhesions, which would interfere with the motions of parts, or even completely destroy their functions. 5. That of relieving the primary constitutional symptoms, and also such consecutive ones as may occur. (See *Clin. Chir.* t. i. p. 483.)

In burns of the first degree, and in those of the second, unaccompanied by detachment of the cuticle, Dupuytren thought that every effort should be made to avert inflammation, and prevent the formation of vesicles or eschars. (See *Clin. Chir.* t. i. p. 484.) This doctrine, which I may say is the commonly received one of the present day, does not agree with the view which was adopted half a century ago by Mr. B. Bell, who did not approve of trying to prevent the formation of vesicles, since he always remarked, that there was less pain when these made their appearance, than when they were hindered from rising by the influence of cold, or astringent applications. All applications, possessing slightly astringent sedative qualities, seem adapted to the fulfilment of this first indication. The part may be dipped in the diluted liquor plumbi acetatis, with a small quantity of alcohol or vinegar in it, or in ice-water, and kept for some time immersed. The late Sir James Earle was a zealous advocate for the use of cold water, or rather ice; but the method is one of great antiquity. "Cold is a remedy which has long been employed to diminish the inflammation of superficial burns. Rhazes directs, that in recent burns, cloths dipt in cold water, or in rose-water, cooled with snow, be applied as soon as possible to the parts which have been injured, and that these cloths be renewed from time to time; and Avicenna says, that this practice often prevents the formation of blisters." (*Lectures on Inflammation*, p. 589.) Sir James Earle's publication, however, had the good effect of drawing considerable attention to the subject, and of leading surgeons to try the method in a great number of instances, in which other more hurtful modes of treatment might otherwise have been employed. The burnt parts may either be plunged in cold water, or they may be covered with linen dipped in the same, and renewed as often as it acquires warmth from the part. The application should be continued as long as the heat and pain remain, which they will often do for many hours. (See *Essay on the Means of lessening the Effects of Fire on the Human Body.* 8vo. Lond. 1803.)

Some caution, however, in the application of cold becomes necessary, when a scald is of very large size, or situated upon the trunk of the body. In extensive burns, superficial as they may be, the patient is liable to be affected with cold shiverings; and these shiverings may be greatly aggravated by exposure, and by the application of cold. No doubt, therefore, in these examples, warm applications ought to be preferred. (*Dr. J. Thomson's Lectures on Inflammation*, p. 591.)

With respect to the topical applications recommended by this gentleman, he generally prefers, in cases of superficial burns, cooling and refrigerant remedies. When there are vesications, and suppuration takes place without ulceration, he advises us, after refrigerants have ceased to produce beneficial effects, to use the linimentum aquæ calcis. However, where the progress of cicatrisation is slow, he recommends, instead of this liniment, ointments containing lead or zinc, particularly the ceratum calaminæ.

When immersion is impracticable, linen, wetted with the above-mentioned applications, may be laid over the burnt parts, and frequently renewed; or, if the cuticle is unbroken, a solution of the sulphate of iron, or of subcarbonate of potassa, or ammonia, will produce very good effects. Dupuytren considered it always of importance to preserve the cuticle over a burn in an unbroken state; and, with this view, he particularly recommends the clothes over the injured part to be taken off with slowness and caution.

When vesications form, some surgeons are in favour of opening them immediately; while others assert that they should not be meddled with. Mr. B. Bell disapproved of opening them till the pain arising from the burn had entirely ceased. Then he thought that they should always be punctured; because when the serum remained a long while upon the subjacent skin, he found it likely to bring on ulceration. He was certainly right in expressing a preference to small punctures; a practice which has the sanction of Dupuytren, who observes, that only a single prick of the vesicle with a needle, or the point of a lancet, should be made in its most depending part.

On the subject of opening vesications in burns, Dr. Thomson believes, that the diversity of opinion arises from the different effects resulting from the particular manner in which the opening is made. "If a portion of the cuticle be removed, so as to permit the air to come into contact with the inflamed surface of the cutis, pain, and a considerable degree of general irritation, will necessarily be induced; but if the vesications be opened cautiously with the point of a needle, so as to allow the serum to drain off slowly, without, at the same time, allowing the air to enter between the cuticle and cutis, the early opening of the vesications will not only not occasion pain, but will give considerable relief, by diminishing the state of tension with which the vesications are almost always, in a greater or less degree, accompanied. When opened in this manner, the vesications frequently fill again with serum; but the punctures may be repeated as often as is necessary, without any hazard of aggravating the inflammation. Great care should be taken, in every instance, to preserve the raised portion of cuticle as entire as possible," &c. (See *Lectures on Inflammation*, p. 595.)

When there is much irritation and fever, bloodletting, and such remedies as the particular symptoms demand, must be advised. On account of the pulse being frequently small, quick, and vibratory, bleeding is at present not often employed. As Dr. Thomson remarks, however, it may become necessary in patients of a strong robust constitution, in whom the symptomatic fever assumes an inflammatory type. He has often seen a single bleeding procure great relief in these cases; and he does not remember a case, where bleeding was followed by injurious effects. (P. 594.)

In burns, if the subject was young, vigorous, and full of blood, Dupuytren advocated local and general bleeding as contributing powerfully to tranquillise the system, and keep down inflammation. He also restricted the patient to low diet in proportion to the severity of the injury.

When the pain and irritation are considerable, Dupuytren, like the generality of surgeons, prescribed opium internally, and with this he combined soothing anodyne applications. The stupor, with which a patient so situated is frequently seized, is sometimes alleged to receive more relief from opium than any thing else.

If, notwithstanding every care, inflammation come on, it is to be moderated, and prevented from invading the uninjured textures, and from attaining a degree in which it may either terminate in gangrene, or produce formidable sympathetic effects on internal organs. According to Dupuytren, therefore, now is the period for having recourse to emollient fomentations and poultices, and to local and general bleeding. If the pain be severe, anodynes should also be prescribed.

The same indications seems to Dupuytren to present itself also in burns of the third and fourth degrees, when the inflammatory process for the detachment of the eschars commences. If the inflammation be too violent, it is to be checked; if the process of separation be languid, it is to be roused. But Dupuytren cautions surgeons never to forget, that, in this case, the employment of too powerfully stimulating applications, or the continuance of them too long, often brings on erysipelas which, originating at the edges of the wound, may invade an extensive portion of the surface of the body, and even prove fatal. Dupuytren affirms, that he generally succeeded in stopping the progress of this kind of erysipelas by laying a blister over the surface attacked. (See *Clin. Chir.* t. i. p. 487.)

But, in the foregoing stage of a burn, other things were insisted upon by this eminent surgeon. One was to cover the burn with fine soft linen, with many holes cut in it, and spread with the saturnine cerate, over which linen was laid a thin stratum of dry charpie for the purpose of absorbing the pus. The detachment of eschars he promoted with emollient poultices; and when they were completely loose, with the exception of a few filaments at the bottom of the ulcer, these he divided with a pair of scissors as closely as possible to the eschars. Sometimes, when the eschar is deep, as in burns of the fourth and fifth degrees, pus collects under it, and its presence is denoted by fluctuation. In this circumstance, Dupuytren recommended incisions to be promptly made, to hinder the matter from extending into the adjacent cellular tissue. When, after the detachment of superficial eschars, or the separation of the cuticle constituting vesications, the exposed cutis was very painful, a cerate containing opium, or dressings wetted with an aqueous solution of the extract of opium, was the application to which Dupuytren gave the preference. (See *Clin. Chir.* t. i. p. 487.)

Another maxim, enjoined by Dupuytren, and which I consider one of the most important in relation to the treatment of burns, is that of changing the dressings quickly, so that the parts may be exposed to the air for as short a time as possible, and with the utmost tenderness. Hence, he used to uncover only a part of the ulcer at a time, and then dress it, before the other dressings were taken off. For this same reason, he considered the separate pieces of Scultetus's bandage more advantageous than a roller.

In extensive burns, and particularly those of the fourth and fifth degrees, the suppuration is generally so profuse, that Dupuytren deemed it necessary to change the dressings two, or even three times a day. But as patients thus circumstanced soon became dangerously reduced and debilitated, Dupuytren used to allow them a nutritious diet, and tonic medicines, especially quinine. The plan of dressing burns, two or three times a day, appears to me rarely advisable; and I do not remember to have seen a single example, in which this frequent exposure and irritation of a burn would have been likely to have proved beneficial. The advice of Dupuytren on this point, I deem one of the few objectionable things in the view which he takes of the treatment of burns. In fact, some of the most approved methods of treating burns are founded upon the opposite principles of exposing injured parts as little as possible to the air, and of letting the applications remain a good while unchanged. The plans here alluded to, however, repress suppuration very considerably, and the discharge is less than in Dupuytren's treatment.

In the ulcerating state of suppurating burns, Dr. Thomson prefers emollient cataplasms. But, when the discharge continues, or becomes more profuse under the use of poultices, they are to be left off, and astringent washes employed, such as lime-water, the compound decoction of oak bark, a weak solution of sulphate of copper, &c.

Where the parts are destroyed and converted into sloughs, Dr. Thomson does not thinks it matters much whether vinegar, oily liniments, turpentine, spirits of wine, or emollient poultices be at first employed. He acknowledges, however, that the poultice is the remedy under the application of which the separation of the dead parts is most easily and agreeably accomplished. "The question," says he, "at present most deserving the attention of medical practitioners, with regard to the use of the warm emollient poultice in burns, is, whether we should apply it immediately after the burn has been received, or interpose for some hours, as has been so strongly recommended, dressings with vinegar, spirits of wine, or oil of turpentine. My own experience has not been sufficient to enable me to determine this point to my entire satisfaction. Yet I think it right to state to you, that, in a number of trials made at different times, I have had occasion to see burns, to which common emollient poultices had been from the first applied, slough and granulate faster, and, in a more kindly manner, than similar burns in the same persons, to which in some instances the Carron oil (lin. aq. calcis), and in others again oil of turpentine, were applied at the same time with the poultices." (See *Lectures on Inflammation*, p. 609.)

In burns, attended with a more or less considerable destruction of textures, the cicatrices which follow are frequently deformed, and sometimes interfere seriously with the free motion of the parts on which they are situated, or even totally prevent the execution of some function. The plan, recommended by Dupuytren for the hinderance of these ill consequences, is to take care that the cicatrix may be of nearly the same extent as the destroyed skin, and that it may not heal by the approximation of its margins to one another. The end may almost always be fulfilled by carefully applying the nitrate of silver to the granulations which are too high; by placing the limb in a proper position; and employing suitable dressings and splints. Thus, if the burn be situated over the flexor muscles, the limb should be kept extended; if over the extensor muscles, bent. Tents, tubes, or pieces of sponge, are to be kept in natural openings, which the healing process may tend to contract or close. Parts, like the fingers, which are disposed to grow together, are to be kept apart with lint or plaster. In the face, where the parts are so moveable and extensible, more or less deformity cannot always be prevented; but the best way of counteracting the tendency to it seemed to Dupuytren to consist in drawing the margins of the ulcer away from one another with straps of adhesive plaster, and other means which circumstances will admit of. But, whenever the attempts to obtain a good cicatrix cause a dangerous degree of suffering, they should be abandoned. (See *Clin. Chir.* t. i. p. 489.)

When the whole thickness of a limb is destroyed, amputation is proper, as substituting a simple wound, the cure of which will be easy, for an eschar, or disorganised mass, the separation of which would be tedious, and followed by an irregular solution of continuity, and a projection of the bone, and other deep textures to which the action of the concentrated heat had least extended. Besides, as Dupuytren justly observes, the operation preserves the patient from the secondary inflammation which would otherwise take place, and not be free from peril. At the same time, before making a decision, the surgeon is to consider the age, constitution, and strength of the patient, and whether he is in a state to bear the process by which the dead parts are to be thrown off. If he were in a condition of stupor, or inflammation had already come on, with fever, &c. the subsidence of these effects, and the establishment of suppuration, must be awaited; after which, a decision for or against amputation should be made, according to the general state of the patient, or that of the ulcerated surface. (See *Dupuytren, Clin. Chir.* t. i. p. 490.)

With regard to constitutional treatment, all surgeons agree with Dupuytren, that when a burn is slight, superficial, of limited extent, and unattended with any disturbance of the economy, it requires no internal treatment. But, although superficial, if it cover a large surface, the patient should be at first restricted to low diet, take cooling diluent beverages, and be kept in a quiet cool room, remote from every thing likely to disturb his mind or body. Dupuytren recommends the same plan to be followed in cases of deep burns. Acute pain is to be assuaged by means of large doses of opium; and fever and inflammatory symptoms are to be repressed by bleeding, especially in strong plethoric subjects; but, when the large size and the depth of the eschars justify the apprehension of the suppuration being extremely abundant, bleeding should be less insisted upon, because the loss of blood would render the patient incapable of bearing the suppuration, and likely to die of exhaustion. In such cases, Dupuytren confined his means for keeping down inflammation to diluents, low diet, and repose.

Suppuration having taken place, and the fever subsided, Dupuytren then ventured to allow his patients a small quantity of nourishing food. When the suppuration became very profuse, and lasted a considerable time, so as to threaten the patient with a dangerous degree of debility, he used to prescribe steel medicines and bark. When hectic symptoms and diarrhœa came on, he gave the patient, three or four times a day, a pill composed of half a grain of the extract of opium, and one grain of sulphate of zinc. When inflammation invaded any of the viscera, this affection was resisted by appropriate menas. (See *Clin. Chir.* t. i. p. 492.)

Dupuytren made some particularly interesting observations on the cicatrisation of burns. In the first degree of a burn, there is, as already stated, no solution of continuity, and consequently no process like cicatrisation. The cure is by resolution. But, in the second degree, the cuticle being detached from the rete mucosum, it must fall off, and will require to be replaced. Here, the reparation, as Dupuytren explains, is affected in three ways, viz. without suppuration, with a slight suppuration of short continuance, or with a long and copious suppuration. In many instances, when the cuticle forming the vesicle is not removed, but remains applied to the rete mucosum, after the discharge of the serosity, no suppuration whatever takes place. A new cuticle is produced immediately under the old one, with various quickness, sometimes in 24 hours, sometimes in two, three, four, five days, or even later. No vestiges of the burn are then left, but a more or less conspicuous redness, which disappears between the twelfth and thirtieth days, the skin resuming its natural colour. If the action of caloric has been more intense, or the cuticle has been removed, and the rete mucosum exposed, the surface of the skin will be attacked by inflammation, more or less acute. In some of these cases, after the discharge of serous fluid for a few days, an inconsiderable and short suppuration occurs, without any remarkable alteration of the rete mucosum. Here the result is nearly the same as that of the foregoing example; the suppurating surface drying up, and becoming covered with a delicate pellicle, the rudiment of the new cuticle, and all traces of the injury being obliterated. But, in many other instances, a profuse suppuration comes on, which, under neglect, or even sometimes under the most skilful treatment, continues a long while, and even occasionally for months. Under these circumstances, either the rete mucosum is completely destroyed, or the organisation connected with it deeply impaired; while, in other examples, it is destroyed at some points, but saved, though altered at others. In the first case, the injury has reached to the cutis; the burn has attained the third degree, and the progress of cicatrisation is the same as what will be presently explained as taking place in the latter. In the second case, the colouring matter usually becomes much deeper than in the natural state. Hence, those yellow, tawny, or brown stains, exhibited by the scars after the cure; stains, which are never effaced, and in which time scarcely ever causes any perceptible modification; and in the negro, the skin becomes even blacker than in the natural state. Lastly, in the third case, the surface of the cutis granulates unequally at every point where the rete mucosum has been completely destroyed. The granulations are sometimes very exuberant, and hence irregular prominences, which continue under the new cuticle, and form more or less numerous columns, crossing one another in different directions. The cicatrix then exhibits an odd appearance; for the rete mucosum not being reproduced, or reproduced but very imperfectly, over the points where it has been destroyed, the columns or projections, resulting from such injury, are of a white colour; while the points of the skin, corresponding to those, where the rete mucosum has been merely changed, are of a brownish tint.*

The foregoing views seem to Dupuytren to suggest certain principles in practice; viz. to keep down any inflammation, likely to rise above the ordinary degree, by all suitable means, emollients, discutients and even bleeding, if necessary; to refrain from employing irritating topical applications; to avoid removing the cuticle; to hinder suppuration from coming on; or, if it has taken place, to endeavour to stop it as quickly as possible. But if suppuration has already continued a good while, cannot be checked, and the rete mucosum is deeply altered, or destroyed, then Dupuytren is an advocate for destroying and levelling the granulations with frequent touches of the nitrate of silver, and for dressing the ulcer with fine linen spread with cerate, and having many apertures cut in it. Such astringents as are calculated to accelerate cicatrisation are also to be applied, and even sheet lead which, by its equable pressure, may be of considerable service. In this manner, Dupuytren found that a smooth flat cicatrix would be obtained, free from deformity. But all means commonly prove ineffectual for the dispersion of the diversified stains, of a tawny, yellow, or brown colour, occasioned by the alteration of the undestroyed rete mucosum, or rather of the minute glands, which secrete it and the colouring matter. (See *Dupuytren, Clin. Chir.* t. ii. p. 5 — 12.)

As already mentioned, the third degree of a burn is characterised by the total destruction of the cuticle and rete mucosum, and by a considerable but not complete destruction of the whole thickness of the cutis. Hence, in this case, there is no reproduction of a complete cutaneous texture, as in a burn of the fourth degree. A layer of skin is yet left, and it is from it that other new and more superficial layers are derived. After the detachment of the eschar, comprising the rete mucosum, and a portion of the thickness of the skin, numerous small red points present themselves on the surface of the ulcer, which exhibits a whitish ground. According to Dupuytren, this is nothing more than the undestroyed portion of the cutis, which soon becomes entirely concealed by the increasing number of red points, and then the ulcer is of one uniform redness. These red points or granulations, by their progressive developement, gradually fill up the chasm left by the separation of the eschar.

It is another remark made by Dupuytren, that however instantaneous the action of the caloric may be, it never extends its effects to precisely the same depth at every point. This is a fact, exemplified in every kind of burn. In burns of the third degree, in some places the rete mucosum alone is destroyed, and the cutis is but very slightly injured; whilst, in other situations, this is more deeply involved, without, however, being completely burnt through. This irregularity in the depth of the injury refers to the inequalities, so often noticed in the granulations, and terminating where cicatrisation is left to itself, in an uneven rugged scar.

In cases of the third degree, Dupuytren considers all those therapeutic means proper which have been specified or called for by burns of the second degree. If the inflammation is too intense, or the suppuration so copious and protracted, as to threaten a complete destruction of the cutis, they are to be diminished. Cicatrisation is to be quickened by appropriate means. Adhesions of parts to one another, and the obliteration of natural openings, are to be prevented by expedients, which will be presently described.

For the correction of the exuberance and irregularity of the granulations, Dupuytren recommends the nitrate of silver to be frequently employed. He also preferred dressings which prevented the pus from lying long upon the ulcer. Hence his custom of covering the whole surface with fine old linen spread with cerate, and full of numerous apertures; of putting over this a layer of dry charpie, and of covering the whole, not with a common roller, but with separate pieces of bandage. Thus the pus, which passed through the perforated linen, was absorbed by the charpie, and, if it was very profuse, it made its escape in the interspaces of the pieces of the bandage.

After a more or less prolonged suppuration, the cellular and vascular granulations are described by Dupuytren as gradually assuming a firmer consistence, and more fibrous character; and the cuticle is deposited over them, which is at first exceedingly fine, and under which the rete mucosum is organised, of a bright red colour, irritable, prone to congestion, and often the seat of erysipelas. The existence of the rete mucosum, though in an imperfect state, and, in most cases, destitute of its colouring matter, was considered by Dupuytren an indisputable fact. Thus, according to his researches, the cicatrix of a burn of this degree is white in the negro, and whiter in the European, than the common skin. In some cases, however, he believed that the pigmentum was entirely or partly reproduced, and imparted to the skin a more or less dark colour. The rete mucosum, when entirely a new formation, seemed to Dupuytren always to be imperfect, and never to resume its original colour: hence irremediable disfigurement.

In the fourth degree of a burn, the whole thickness of the skin is burnt through and destroyed;

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* If Breschet's views of the structure of the skin be correct, then, instead of referring these differences to the injured, uninjured, or destroyed state of the rete mucosum itself, we must ascribe them to the accidental condition of the minute glands, which are described by Breschet, as the sources of it, and to the state of the colouring apparatus.

but the subcutaneous cellular tissue, though exposed, is either not all, or but slightly injured. In this case, according to Dupuytren's investigations, cicatrisation takes place in several ways. 1. After the detachment of the eschar, the edges of the ulcer insensibly approach one another, and unite. 2. Or else the edges of the ulcer being retained in their respective situations, a new cutis is produced from the subcutaneous cellular tissue. 3. Or, lastly, both these processes are combined.

After the detachment of the eschar, the bottom of the ulcer is described by Dupuytren as formed by the cellular tissue; its margins exhibit a red circle, which is the rete mucosum, and under it, more deeply, a white circle, which is the cutis. The surface of the ulcer is reddish and granular: it diminishes from day to day; its swollen edges subside and approach one another; the surrounding skin yields, and is more or less displaced and dragged, according to the extent of the chasm. If this extent is too considerable, then, after the skin has yielded as far as possible, a new texture is produced, which serves as a substitute for those which are destroyed. On the contrary, if the edges of the ulcer can be made to meet, their union is accomplished after a suppuration of longer or shorter duration. Dupuytren further states, that this is what happens when the skin is not able to yield, or extend itself, and the parts are put into a position which allows the sides of the ulcer to be brought into contact. But if the approximation of the margins of the ulcer to one another is prevented, either by the unyielding nature of the parts, or by the interference of the surgeon, then a new tissue is generated, which is endued with very peculiar properties. (*Clin. Chir.* t. ii. p. 17 — 19.) — This tissue, which is alleged by Dupuytren to be fibro-cellular, constitutes the cutis. As soon as it is formed, the new integuments are promptly completed; a rete mucosum, very imperfect indeed, and destitute of colouring matter, covers the cutis, and is itself quickly covered by cuticle, the qualities of which differ but little from those of the original.

Dupuytren concurs with Hunter in representing the formation of a new skin as a difficult task for nature: and this texture is always organised slowly, when the ulcer is of considerable extent; but when this has been accomplished, cicatrisation is soon completed. Thus it is surprising to see an ulcer, which has continued for months without any particular change, all on a sudden heal up in a few days. (See *Clin. Chir.* t. ii. p. 25.)

Dupuytren enters into some very interesting reflections on the surgical plans which are to be adopted, in order to make the cicatrix correspond as accurately as possible to the destroyed textures. The first is, *position of the limb or part.* Here the general maxim is to let the position of the part be diametrically the reverse of what would promote the cure, by bringing the edges of the ulcer towards one another. The desideratum is to obtain a cicatrix, whose extent should be equal to that of the destroyed skin, and even somewhat greater, on account of the contractile property of the new texture. Thus, if the burn is on the front of the elbow, the arm is to be kept forcibly extended, until the substance of the cicatrix has been formed. The same plan is applicable to burns of the anterior part of the fingers, hand and wrist, groin, sole of the foot, ham, &c. Supposing the burn to be on the back of the neck, the chin is to be kept approximated to the chest; but, on the contrary, if the burn is on the forepart or side of the trunk, the opposite position is to be maintained. If the burn is on the front of the knee, or back of the elbow, the leg, or forearm, should be kept half bent, or, what is still better, in a state of complete and forced extension. When the armpit is burnt, the arm should be kept in the position of abduction; but, in that of adduction, when the top of the shoulder is the seat of the burn. (See *Clin. Chir.* t. ii. p. 27.)

Dupuytren notices some circumstances, however, under which it is difficult, or impossible, for the foregoing principle to be acted upon in practice. Such is the case where the skin all round the member has been destroyed to some extent: by adopting one position, the advantages of another would be lost. Here Dupuytren advises a position to be selected which will leave a cicatrix that will interfere least with the free movements of the part. Thus, if the burn occupies the whole surface of the radio-carpal articulation, it is better to keep the wrist extended than bent, because the cicatrix, which would confine the joint in the first posture, would be less inconvenient than one which would fix it in the second. In some of these perplexing cases, Dupuytren considers it advantageous to adopt different positions alternately, and to hasten cicatrisation on one side, and retard it on the other. (See *Clin. Chir.* t. ii. p. 29.)

Mr. Earle is of opinion that, by due attention to certain principles, the deformities from burns may generally be avoided. "I am quite ready to admit (he observes), that it is not in our power to arrest the law of nature, by which a cicatrised surface becomes smaller, and occupies less space, than the original wound; but it is in our power, in most cases, to direct and modify that which we cannot wholly prevent; and thus, at all events, to counteract its injurious effect. We cannot prevent the process of absorption (of the granulations), but we can prevent its taking place in a direction which may interfere with the healthy functions of the part. To take the upper extremity as an example. I will suppose a case, where the whole integuments on the inner and front part of the arm and forearm have been destroyed. If such extremity be kept carefully extended on a splint, not only during the whole progresss of healing, but long subsequent to the perfect cicatrisation, you will find that the cicatrised surface will diminish in a circular direction, drawing the healthy integument together from side to side; but, that no contraction will take place in the long axis, in which alone it can impede the due motions of the limb. This permanent extension should be persevered in during the day and night, until all changes have ceased, and the cicatrix has contracted to its smallest dimensions. Care, however, should be taken, during this time, to give passive motion to the different joints, by which the proper secretion of synovia will be kept up, and the eventual free use of the limb will be insured. This plan of maintaining the limb in state of permanent extension should be commenced as soon as the wound has begun to granulate." (See *Earle's Lect. on Burns*, p. 43.)

Cases are noticed by Dupuytren, in which the plans calculated to produce a good cicatrix cannot be persevered in without danger; as, where the patient is likely to be exhausted by the long and profuse discharge. Here, instead of retarding the formation of the cicatrix, and compelling nature to fill up the chasm with a new texture, it is necessary to expedite it by favouring the approximation of the edges of the ulcer to one another, promoting the developement of the tissues of union, or exciting inflammation when it is languid, and repressing it when it is too violent. But, in such cases, it is prudent to follow Dupuytren's advice in apprising the patient, or his friends, of the necessity for this plan, and of the deformity which will unavoidably follow it.

There are also certain regions of the body, specified by Dupuytren, where no advantage can be derived from position, and where it is exceedingly difficult to prevent deformity. Such, in particular, is the face. Thus, if a burn of the fourth degree were to destroy a portion of the lower eyelid and cheek, it would be impossible to hinder the edges of the ulcer from getting nearer together, and the eyelid would be drawn down until it almost formed a junction with the upper lip. If a similar burn were to occur on the forehead, temples, upper eyelid, or scalp, an analogous deformity would be the result. Feeble as the means are which are within the surgeon's reach, when position is unavailing, they should never be neglected. Here, as Dupuytren explains, it is proper, 1. To retard, as much as possible, the detachment of the eschar, which, so long as it remains, has the effect of keeping the edges of the ulcer apart. The healing processes commence under it, and the margins of the chasm, becoming more fixed to the subjacent textures by inflammation, are less disposed to be drawn towards one another when the separation of the eschar does take place. 2. As soon as the latter event has occurred, cicatrisation is to be quickened, by frequently touching the ulcer with the nitrate of silver. Care is also to be taken to prevent any cicatrising points in the centre, or at the circumference of the ulcer, from being destroyed, by the pus being suffered to continue too long in contact with them. Hence, Dupuytren was an advocate for frequently washing the part, and renewing the dressings.

Position, by means of which a good cicatrix has been obtained, is recommended by Dupuytren to be continued a month, six weeks, or even longer, after the cure.

It is not only necessary to place the parts in the desirable position, but also to maintain it by means of a bandage, or apparatus. Thus, when the burn is situated on the anterior, posterior, or lateral part of the neck, the head is to be kept inclined in one direction or another, with straps or bands, fastened to a bandage on the body. When the burn is on some part of the wrist, Dupuytren used to put along the forearm on the side furthest from the injury, a pad of a certain thickness which descended to the joint without going beyond it. Over this he laid a splint of sufficient length to reach to the ends of the fingers, and then, availing himself of the vacancy between the hand and the splint, he kept the former inclined towards the latter with a few additional turns of the roller employed to fix the pad.

When the burn involved the palm of the hand, or passed between the fingers, Dupuytren used to place the pad along the back of the forearm, carpus, and metacarpus, and then a splint terminating below in a hand board, and long enough to cover the whole hand, even when the fingers were extended, and widely separated from one another. The hand board, at the points corresponding to the extremities of the fingers, had ten slits in it, intended for the reception of the ends of five pieces of tape, which formed so many nooses for the confinement of the fingers. Or the hand board, instead of having fissures, was adapted to the shape of the hand, and furnished with prolongations for the fingers.

In burns of the second and third degrees, Dupuytren found, that adhesion of contiguous parts might be prevented by keeping them apart by the interposition of some extraneous body, moving them about, and passing a probe between them at every time of dressing them; but that, when the burn was of the fourth degree, these means were not effectual. Thus he found it not enough to maintain the fingers separated and extended, but that it was essential to make more or less pressure directly on the point where the cicatrix began. This pressure was made by means of a long narrow compress, the middle of which was applied precisely to the angle of the commissure of the fingers, while the two ends were carried over the front and back of the forearm, and there fastened. The same principle is applicable to other similar cases.

When a burn of the fourth degree implicated the circumference of natural orifices, as those of the nostrils, vagina, mouth, &c., Dupuytren used to prevent the obliteration of such apertures with dossils of lint, tents, cannulæ, prepared sponge, ivory tubes, &c. Attention to this indication seemed to him here as proper as in burns with vesication, or those of the third degree; but, with these differences, 1. That they are even more rigorously indispensable. 2. That the diameter of the foreign bodies must always exceed that of the orifice into which they are introduced. 3. That their use must be continued long after the cure, in order to resist the contractile tendency of the cicatrix.

Amongst the means for fulfilling the indication under consideration, are straps of adhesive plaster. But Dupuytren correctly observes that, though they are very efficient when they are applied across an ulcer, in keeping its edges approximated, their action is but feeble when employed for maintaining them apart. Yet he admits that circumstances occur, in which they are of service. Such are burns of the face, forehead, temples, scalp, &c.; where the parts cannot be operated upon by position and other means.

In burns of the fifth and sixth degrees, implicating the muscles and tendons, a chief object is to keep the limb or part in such a position as will leave after the cure the least inconvenience. In general, as Dupuytren remarks, the disorganisation is so considerable, that the preservation of the patient's life, by promoting cicatrisation by every possible means, engages all the surgeon's attention, who has now no opportunity of thinking about the prevention of deformity, or the losses of functions resulting from it. (See *Clin. Chir.* t. ii. p. 33—39.)

Of the Means for correcting the Deformities, and relieving the Impairment of Functions arising from the unfavourable Cicatrisation of Burns.

These deformities consist of inequalities, fleshy bands, fræna, adhesions, depressions, a puckering up of the part, and discolourations or stains of the skin.

With respect to the marbled or mottled discolourations left as consequences of exposure to moderate degrees of heat, the treatment recommended by Dupuytren, consists in removing the exciting cause, and using astringent lotions, particularly those of the acetate of lead. He acknowledges, at the same time, that the plan is generally unavailing, and suspects, that it would prove more successful, if combined with methodical compression. The slow and prolonged action of caloric here adverted to, he found to be not unfrequently the cause of varices.

The following are some examples of the various deformities, which Dupuytren had known to follow burns. In some patients, all the integuments at the base of the skull, and with them, the ears and eyebrows, were strongly drawn upwards by a cicatrix, which had contracted itself towards the top of the head. In others, the eyebrow and upper eyelid were drawn up, and rendered immoveable by a cicatrix on the forehead. In one, the eyelids were everted by scars on their fore part, or at the base of the orbit. In another, the commissures of the eyelids were drawn outwards or inwards by cicatrices on the temple, or root of the nose; or the ala of the nose was pulled upwards by a cicatrix above it, and the nostril obliterated. In others, again, the commissure of the lips was drawn upwards, outwards, or downwards, by cicatrices on various parts of the cheek; or the upper lip was united to the septum of the nose; or the lower one to the chin, so as to be incapable of preventing the escape of the saliva. In others, the ears adhered to the temples, and the meatus was contracted, or obstructed; or the chin, with its prominence effaced, was fixed to the front of the neck, or upper part of the chest; or the skin of the neck adherent to the thyroid cartilage, or hyoid bone, whence a difficulty of swallowing, and an incurable *enrouement:* In other instances, the shoulder was drawn upwards, and the head to one side, by a cicatrix on the lateral part of the neck. In some girls, in consequence of the horrible mutilation of the breast, the mammary glands could not be developed, or serve for the secretion of milk. In other cases seen by Dupuytren, the trunk was bent forwards, by bands extending from the front of the chest to the abdomen; or the shoulder was depressed towards the hip, and this pulled upwards by a cicatrix on the side of the trunk; or the elbow was fixed close to the side by a cicatrix in the axilla, resembling a kind of fin, when an attempt was made to lift the humerus from the side; or the forearm was held in the bent position by the effects of a cicatrix situated on the front of it, or the upper arm. In other instances, the wrist was bent or extended, or the fingers similarly affected were all united, and blended together in one mass, covered by the cicatrix. Dupuytren had seen the penis either fixed to the linea alba by a cicatrix which represented a sort of fold, like what prevails in quadrupeds; or else drawn to one side, and adherent to the scrotum, which had grown to the thighs. In one case, the thigh, was fixed in the bent posture by a cicatrix in the groin, which cicatrix, though scarcely apparent when the limb was quiet, was converted into a very prominent band by the least movement of extension. Dupuytren had known the abdominal ring so weakened by a cicatrix in front of it, that a hernia took place, attended with the peculiarity, that the cicatrix formed such a projection when the limb was extended, that it prevented the patient from keeping up the bowels with a truss, until it had been divided. In other cases, he had seen the leg kept permanently bent by bands in the ham; or the feet twisted outwards or inwards, in consequence of burns on the sides of these parts, or the legs, which had occurred in early life; or the toes pointing straight upwards, or downwards, sometimes with their dorsal surface directed towards the ground, so as entirely to incapacitate the patient from walking.

Mr. Earle has known the contraction of the cicatrix of a burn act with such force, as to bring the shoulders towards one another by a partial absorption of the clavicles. He mentions another case, in which, not only the whole head was bowed down towards the sternum, but the lower jawbone curved downwards, so as only to admit of the last molar teeth coming in contact; the mouth being kept permanently open, and the direction of the incisor teeth so altered, that they projected nearly in a horizontal line. In a third case, the arm was pinioned to the side, and the hair and scalp drawn many inches down the back between the scapulæ. (See *Two Lect. on Burns*, p. 41.) Such, indeed, is the force adverted to, that dislocations may be produced by it. I have known instances of this with reference to the thumb and fingers; and Cruveilhier describes the particulars of a rare example, in which the carpus was luxated from the radius from the same cause. (See *Anat. Pathol. Livr.* ix.)

However numerous or diversified the deformities from burns may be, Dupuytren considered all of them as admitting of being classed under a few heads. All of them consist either of *cicatrices*, which are *too narrow*, or *too prominent;* or in unnatural *adhesions*, or *obliterations*, or in *losses of organs.*

With respect to operations undertaken for the cure of deformities from burns, Dupuytren lays down the following principles:—1. The attempt should never be made till several months, or even years, after the formation of the cicatrix. This rule, he says, cannot be deviated from, without the risk of incurring a great loss of substance produced by the destruction of the new-formed substance of the cicatrix. 2. An operation should never be practised, unless a larger and less deformed cicatrix than that which it is wished to correct, can certainly be obtained with the aid of position and bandages. This precept Dupuytren deemed specially applicable to cicatrices on the face, which in general should not be meddled with. 3. An operation should only be undertaken when it will restore the original shape and functions of the parts. Hence, it must be abstained from whenever anchylosis exists, or the muscles and tendons are destroyed. Occasionally, however, it may be performed for the removal of deformity, though the functions of the part cannot be restored by it. (See *Clin. Chir.* t. ii. p. 51. &c.)

But in what manner, and according to what rules, is the operation, if judged advisable, to be performed? Now Dupuytren does not admit, 1. That every operation which leaves the texture of the cicatrix subsisting, will be followed by a return of the contraction as before. 2. Or that, in order to attain success, it is absolutely necessary to cut away the cicatrix, and then bring the edges of the wound together, so as to unite them by the first intention. He found, that when the cicatrices had, after a length of time, acquired their complete solidity, and the fræna or bands had become perfectly organised, that the substance of the cicatrix is scarcely more disposed to contract than an original texture. Hence the rule which he lays down, that no surgical operation should ever be done until the cicatrices and adhesions have attained this perfect organisation. When the object was to remedy too narrow a cicatrix, Dupuytren used, 1. To make, at various points of the frænum, transverse incisions completely through it, so as to be able perfectly to extend it without removing any of its texture. 2. To extend the parts, and bring them into the opposite direction to that in which they had been drawn by the burn, and thus obtain a cicatrix by the production of a new cutaneous tissue. The requisite position was then maintained by means of bandages, machinery, &c, If the parts were supple and yielding, they were put at once into the right posture; in the opposite case, a slow and gradual extension of them was made, for which purpose Dupuytren conceived that splints furnished with elastic springs, so as to keep up a gentle but permanent effect, would be of great use. In this country splints with hinges, and allowing their angle of flexion to be regulated by a screw, are often employed. 3. The operation having been performed, the case seemed to Dupuytren to be nearly in the same condition, as directly after the separation of the eschar. Hence his advice is, that the formation of the cicatrix should be regulated by the means already specified; and every effort made to hinder it from taking place by the approximation of the edges of the wound. If secondary fræna or bands form, they are to be immediately cut through without sparing one of them. To the neglect of this precept, Dupuytren ascribes the failure of many operations.

If the removal of too prominent a cicatrix was the object, Dupuytren first sliced off the projecting part of it on a level with the skin: secondly, he kept the edges of the wound apart: thirdly, he frequently cauterised the surface so as to keep it rather below the level of the integuments. (See *Clin. Chir.* t. ii. p. 68.)

Instead of slicing off the prominent cicatrix, Mr. Higginbottom rubs it with the nitrate of silver, exposes it to the air for three days, and then covers the part with ointment. The application is repeated as often as necessary. (See *J. Higginbottom on the Use of the Nitrate of Silver*, p. 157. ed. 2.)

If the deformity consisted in simple adhesions, Dupuytren's practice was as follows: — 1. After having divided them, he dissected them freely to beyond their origin. 2. Then he drew the parts asunder. 3. Methodical and constant pressure was maintained on the point whence the cicatrix must proceed, which is always at the angle of union of the parts. (*Clin. Chir.* t. ii. p. 69.)

When the surfaces adherent to one another are extensive, as in cases of union of the arm to the trunk, or the two thighs together, Dupuytren cautions surgeons not to complete the operation at once, as dangerous consequences may follow so large a wound. The same rule is applicable to extensive callous prominences. Here it is best to proceed by fractions, and to let the wound of one operation be cured before another is undertaken. (P. 73.) Another important caution, given by Dupuytren, is, to be certain, before any operation is attempted, that the limb, retained in a faulty position, is not incapable of being brought into a better one; if there were deformity of the articular surfaces, anchylosis, or atrophy of the limb, the division of the adhesions and contractions would be entirely useless.

Mr. Earle admits that, in recent cases, occurring in any of the extremities, and where the contraction is confined to the integuments, the division of it may remove the deformity for a time; but, he maintains, that when the contraction has been of longer duration, the muscles acquire a new sphere of action, and afford an additional and powerful opposition to the free exercise of the limb. In some cases, he observes, even the bony fabric becomes moulded and altered by the powerful constriction exerted on it. In such circumstances, he regards transverse incisions and other severe operations as promising not even a prospect of temporary alleviation. Hence in a case which was under his care in 1813 (See *Med. Chir. Trans.* vol. v. p. 96. &c.), he was induced, like Hildanus, to remove the whole of the diseased cicatrix, and to bring the healthy integuments together from the two sides of the arm, which was kept extended on a splint, not only during the healing of the wound, but for a considerable time after the new cicatrix had formed. Under such treatment, he conceived, that the contraction would take place in a lateral direction, and not in the long axis of the limb. This case proved completely successful as well as many others under Mr. Earle himself, Sir Benjamin Brodie, Mr. James of Exeter, and Mr. Hodgson of Birmingham. (See *Earle's Lect. on Burns*, p. 51).

Mr. James constructed an apparatus for keeping the chin elevated after operations for relieving contractions of the neck. This plan, with certain modifications, Mr. Earle has found answer, not only for curing but preventing such contractions. In slighter cases, a stiff soldier's collar, worn night and day, will be a sufficient protection against contraction, provided the skin directly below the chin be not burnt. (P. 53.)

When Dupuytren had to deal with a contraction or obliteration of some natural opening, 1. It was enlarged, if only lessened; but perforated again, if obliterated, with a cutting instrument or trocar. 2. Dossils of lint, tents, or ivory tubes, much wider than the natural openings, were then introduced, and kept in, not only until the cicatrix had formed, but for a long while afterwards.

For the prevention of the return of the contraction, Dupuytren strongly insisted on the necessity of persevering with the means calculated to resist it, until the cicatrix had lost this tendency by attaining its definitive organisation; and, besides machinery, he had recourse, occasionally, to warm bathing, *douches*, emollient applications, and oily embrocations.

CLEGHORN'S PLAN OF TREATING BURNS.

This consisted in the immediate application of vinegar, which was continued until the pain abated; and when this returned, it was repeated. If there were eschars, these, after the pain had ceased, were covered with a poultice for six or eight hours, after which, the parts were sprinkled with finely powdered chalk, so as to remove every appearance of moisture. The whole surface was then poulticed again; and the same mode was pursued every night and morning, until the cure was complete. If the use of poultices relaxed the ulcers too much, a plaster, or ointment, containing the acetate of lead, was applied; but the chalk was still sprinkled upon the sore.

With respect to general remedies, Mr. Cleghorn allowed his patients to eat boiled, or roasted fowl, or, in short, any plainly dressed meat which they liked. He did not object to their taking moderate quantities of wine, spirits and water, ale, or porter. He never had occasion to order bark, or any internal medicines whatever; and he only once thought it necessary to let blood. When the patient was costive, Mr. Cleghorn ordered boiled pot-barley and prunes, or some other laxative nourishing food, and sometimes an injection, *but never any purgative*, as he remarked that the disturbance of frequently going to stool was distressing to a patient with bad sores. Besides, he thought, that a hurtful weakness and languor were always (more or less) brought on by purgatives.

In cold weather, Mr. Cleghorn sometimes warmed the vinegar a little, placed the patients near the fire, and gave them something warm internally. His object in so doing was to prevent the occurrence of tremblings, and chilliness, which, in two instances, after employing cold vinegar, took place in an alarming degree. The account of Mr. Cleghorn's plan was published by Mr. Hunter. (See *Med. Facts and Observations*, v. ii.) In this gentleman's use of fine chalk may be recognised the commencement of the analogous practice of covering burns with flour, which is chiefly useful on the principle of excluding the air.

Dr. Kentish's Plan.

The fanciful theories advanced by Dr. Kentish, lead him to believe, that as burns are injuries attended with increased action, there are two indications for restoring what he terms *the unity of action:* viz. the excitement, or action, of the part is first to be gradually diminished; secondly, the action of the system is to be increased to meet the increased action of the part, according to the following law: *That any part of the system, having its action increased to a very high degree, must continue to be excited, though in a less degree, either by the stimulus, which caused the increased action, or some other having the nearest similarity to it, until by degrees the extraordinary action subsides into the healthy action of the part.*

With this view, holding the part to the fire, seems, to Dr. Kentish the best mode of relief; but, as parts of the body are injured, to which this cannot be done, stimulant applications must be used. The strongest rectified spirits, made still stronger by essential oils, are proper, and may also be heated as much as the sound parts can bear. These, and many other applications of the same class, says Dr. Kentish, will give the most speedy relief. They are, after a certain time, to be succeeded by less stimulant applications, until the parts act by common natural stimuli.

The internal mode of relief is, to give those substances which most speedily excite the system to great action, such as æther, ardent spirits, opium, wine, &c., by which means, the solution of continuity of action is allowed to last the shortest time possible, and the unity of action is restored, which constitutes the cure.

After explaining his principles, Dr. Kentish takes notice of the various substances, which have commonly been employed. Of these he would chiefly rely on alcohol, liquor ammoniæ subcarbonatis, æther (so applied as to avoid the cooling process of evaporation), and spirit of turpentine.

In applying these, we are directed to proceed as follows: — The injured parts are to be bathed, two, or three times over, with spirits of wine, spirits of wine with camphor, or spirit of turpentine, heated by standing in hot water. After this a liniment, composed of the ceratum resinæ softened with spirit of turpentine, is to be spread on soft cloth, and applied. This liniment is to be renewed only once in twenty-four hours, and, at the second dressing, the parts are to be washed with proof spirit, or laudanum, made warm. When the secretion of pus takes place, milder applications must be made, till the cure is effected.

The yellow ointment stops the pores of the cloth, impedes evaporation, and thus confines the effect of the alcohol to the burnt surface. The first dressings are to remain on four and twenty hours. Dr. Kentish thinks it of importance, that the injured surface should be left uncovered as little as possible. It is therefore recommended to let the plasters be quite ready, before the old ones are removed, and then only to take off one piece at a time.

It will seldom be necessary to repeat the application of alcohol, or that of oleum terebinthinæ. The inflammatory action will be found diminished, and, according to Dr. Kentish's principles, the exciting means should therefore be diminished. Warm proof spirits, or laudanum, may be substituted for the alcohol, and the unguentum resinæ flavæ is to be mixed with oleum camph. instead of turpentine. If this should be found too irritating, Dr. Kentish recommends ceratum plumbi acetatis, or cer. calaminæ. Powdered chalk is to be used to repress the growth of exuberant granulations, and to absorb the pus. Into the cavities of separated eschars, and into the furrows, between sloughs and living parts, he introduced powdered chalk. Then a plaster was applied, and, in tedious cases, a poultice over the plaster.

With respect to the internal treatment, the author observes, that great derangement of the system arises in certain persons, from causes, which, in others, produce no effect; and that this depends on a difference in the degree of strength. Hence, he concludes, that as strength resists the sympathetic irritative actions of parts, and weakness induces them, we should, in all cases, make the system as strong as we can, immediately upon the receipt of the injury. In considerable burns, he supposes a disproportion of action to take place between the injured parts, and the system at large, or what he styles a solution of the continuity of action; and that, by a law of the system, a considerable commotion arises, for the purpose of restoring the equilibrium, or enabling the constitution to take on the action of the part. Hence, Dr. Kentish is of opinion, that the indication is *to restore the unity of action of the whole system, as soon as possible*, by throwing it into such a state as to *absorb the diseased action*, and then gradually bring down the whole to the natural standard of action, by nicely diminishing the exciting powers. Æther and alcohol, or other stimulants, are to be immediately given in proportion to the degree of injury; and repeated, once or twice within the first twelve hours, and afterwards wine or ale to be ordered, till suppuration takes place, when it will be no longer necessary to excite the system.

In a second essay, Dr. Kentish remarks, that in the first species of burns, *in which the action of the part is only increased*, he has not found any thing better for the first application, than the heated oleum terebinthinæ and ceratum resinæ, thinned with the same. In superficial burns, when the pain has ceased, he considers it advisable to desist from this application in about four-and-twenty hours, and use at the second dressing a digestive, sufficiently thinned with common oil, beginning, on the third day with the ceratum lap. calaminaris. This author has frequently seen secondary inflammation excited by the remedy. The most certain remedy for this unpleasant symptom, is a digestive ointment, thinned with oil, or a plaster of cerate, and over that a large warm poultice. The cerate will finish the cure. Should there be much uneasiness of the system, an anodyne, proportioned to the age of the patient, should be given.

The growth of fungus, and the profuse discharge of matter are to be repressed, as already mentioned, by sprinkling finely levigated chalk on the surface, and by the use of purgatives in the latter stages.

We learn from Dr. Reese, that Dr. Kentish's treatment is still the most popular in the United States, and that alcohol, spirits of turpentine, and the mixture of linseed oil and limewater, are in almost universal use. (See *Amer. ed. of this Dict.*)

Of dressing Burns with carded Cotton.

In America one of the best applications for superficial burns is found to be *raw cotton*, thinly spread out, or carded, and put directly on the injured parts. (See *Dallam on the use of Cotton in Burns, in Potter's Medical Lyceum*, p. 22.; *and Gibson's Institutes and Practice of Surgery*, p. 62. vol. i. 8vo. Philadelphia, 1824.) According to Professor Gibson, it is only in superficial burns that this practice answers; but Dr. Anderson, of Glasgow, who has tried it on a large scale, represents it as applicable to injuries, whether occasioned by scalding, or actual fire; whether superficial, or deep, recent or old, vesicated or sphacelated. He states, that it has been long adopted by the inhabitants of the Greek islands. One of its advantages, he says, is, that, except in cases of deep injury, the cure is always accomplished without any appearance of cicatrisation. (See *Glasgow Med. Journ.* vol. i. p. 209.) Another is the avoidance of the pain always attending the frequent renewal of other kinds of dressings; for this is left unchanged a considerable time. Some care, says Dr. Anderson, is necessary, both in preparing and applying the cotton. For this purpose, it should be finely carded, and disposed in narrow fleeces, so thin as to be translucent; by which means it can be applied in successive layers, and is thus made to fill up and protect the most irregular surfaces. The burnt parts, if vesicated, are to be washed with tepid water, and the fluid evacuated by small punctures. Or, if more deeply scorched, they may be bathed with a spirituous or turpentine lotion. The cotton is then applied, layer after layer, until the whole surface is not only covered, but protected at every point, so that pressure and motion may give no uneasiness. On some parts it will adhere without a bandage, especially when there is much discharge; but, in general, a support of this kind is useful. Where the vesications have been broken, and the skin is abraded, or where there is sphacelus, more or less suppuration always ensues: and, in such cases, Dr. Anderson admits, the discharge may be so great as soon to soak through the cotton, and become offensive, particularly in summer, so that it may be necessary to remove the soiled portions. This, however, he advises to be done as sparingly as possible, care being taken to avoid uncovering or disturbing the tender surface. (*Op.* cit. p. 213.) According to Dr. Anderson, there appears to be a twofold effect from this kind of treatment. The primary effect arises from the exclusion of the air, and the slowly conducting power of cotton, by which the heat of the part is retained, whilst a soft and uniformly elastic protection from pressure is afforded. The secondary effect, he says, depends entirely on the sheath, or case, formed by the cotton, absorbing the effused serum, or pus, and giving the best possible substitute for the lost cuticle. "But, in order that the full benefit may be derived from this substitute, and to ensure an equable and continued support to the tender parts, until the new skin is formed, it is absolutely necessary that the cotton should not be removed, except under particular circumstances, until the real cuticle is sufficiently formed to bear exposure." (P. 217.) If much constitutional irritation be evinced after the cotton has been for some time applied, Dr. Anderson confesses that it may be necessary to let out the discharge, or even remove the cotton altogether. "We are then to be guided by the symptoms and appearances, whether to reapply the same dressings, or first restore a more healthy action in the constitution." (P. 219.)

Mr. M'Intyre, of Newcastle, lately gave me a favourable account of his trials of this method.

Dr. Reese, of New York, the learned editor of the American edition of this Dictionary, admits, that "*the exclusion of the air*" is the true indication in the treatment of burns; but, that it is imperfectly fulfilled by the carded cotton. "In superficial burns, salt has long been a domestic application, and can only act in this way; yet, when the part is completely covered with a layer of salt, the relief is immediate, and, in superficial burns, is permanent." (See *Reese's Amer. ed. of Cooper's Dict.*)

Of dressing Burns with Flour.

I believe that one of the most important principles in the treatment of burns, is to exclude them as much as possible from the air, and that it is in this way that the treatment with powdered chalk, the linimentum calcis, the linimentum terebinthinæ, flour, &c. proves very commonly advantageous. In particular, several of these applications supersede all occasion for an early or a frequent removal of the dressing, and exposure of the part. When it is considered what agony is thus prevented, we cannot wonder that the simple application of flour should have come into extensive favour. In the North London Hospital, it is employed with great success, fresh flour being sprinkled with a dredger over the parts from day to day, at each point where matter shows itself in the stage of suppuration.

When the flour is to be discontinued, the masses of it are covered with a poultice, which softens them, and makes their removal easy. Then the surgeon may have recourse to the same application, or others, according to circumstances.

The following passage, in relation to this subject, I find in Reese's American edition of this Dictionary: — "As the relief afforded in burns is generally the result of the exclusion of the air from the raw surface, the modern practice, introduced on the Continent, of covering burns with wheat flour, or other farinaceous material, will be found by far the most immediate in its action, and the most successful in its results; and this application is adapted to every species of burns, whether occasioned by scalding, or actual fire; whether superficial or deep, recent or old, vesicated or sphacelated. In the most desperate burns, where the injury is extensive, and the destruction of the cutis almost universal, the patient is unable to sustain either the refrigerent treatment, or any modification of Dr. Kentish's plan. In these shocking cases, if the flour be applied all over the injured surface, until the air is entirely excluded, the pain is almost annihilated; and, from the most excruciating torture, the patient is instantly placed under circumstances of comparative comfort. The flour should be repeatedly applied, and persevered in, until the acute inflammation is removed, or, in common parlance, 'the fire is out.' No other application, or dressing will be necessary till the acute stage is past; and then the plan of Dr. Kentish, modified according to the circumstances of the case, will be found adequate to the restoration of the injured surface, however extensive. I can confidently recommend this practice, having witnessed its success in the most hopeless cases." (*Reese.*)

Larrey's method of dressing burns with fine old linen, spread with saffron ointment, is probably useful also on the principle of excluding the air. He continues this application till suppuration has taken place, after which the styrax ointment is employed for promoting the detachment of the eschars. As soon as this has been accomplished, the saffron ointment is applied again, and subsequently dry lint, covered with strips of linen spread with cerate. When the granulations rise too much, he uses the nitrate of silver, and sometimes a weak solution of oxymuriate of mercury, or sulphate of copper. He also prescribes milk of almonds with nitrate of potassa; and allows his patients broth, jellies, eggs &c. (See *Mem. de Chir. Milit.* t. i. p. 93.)

See *B. Bell*'s System of Surgery. Medical Facts and Obs. vol. ii. *J. Sedillot*, De Ambustione Theses, 4to. Parisiis, 1781. *Sir James Earle*'s Essay on the Means of lessening the Effects of Fire on the Human Body, 8vo. Lond. 1799. *Kentish*'s Two Essays on Burns, the first of which was published in 1798. *Robert Lyall*, in Edin. Med. and Surg. Jour. vol. vii. p. 313. *Hedin*, Diss. sistens Observationes circa vulnera ex combustione, &c. 4vo. Upsaliæ, 1804. *Larrey*, Mémoires de Chirurgie Militaire, t. i. p. 93—96. *Boyer*, Traité des Maladies Chir. t. i. p. 160. *Nodes Dickinson*, on Burns and Scalds, Lond. 1818. Lectures on Inflammation, by *John Thompson*, p. 585., &c. Edin. 1813. *Anderson*, in Glasgow Medical Journ. vol. i. *Gibson*'s Institutes of Surgery, vol. i. Philadelphia, 1824. *Andral* Précis d'Anat. Pathol. t. ii. p. 223. *J.^{n} Higginbottom* on the Use of the Nitrate of Silver, chap. 7. ed. 2. 8vo. Lond. 1829. *M. Le Baron Dupuytren*, Leçons Orales de Clinique Chirurgicale, t. i. art. 16. t. ii. art. 1. 8vo. Paris, 1832. *H. Earle*, Two Lectures on the Primary and Secondary Treatment of Burns, 8vo. Lond. 1832.

BURSÆ MUCOSÆ. Small sacs of synovial membrane, interposed, either between the periosteum and the skin; or between the periosteum and muscles; or between the periosteum and tendons; or between tendon and tendon. The slippery fluid, which they secrete, serves to lubricate the surfaces over which it passes. The subcutaneous bursæ are either natural, like those upon the patella, or the olecranon, or are developed in the common cellular tissue by pressure. (See *Mayo's Outlines of Human Pathology*, p. 110.) It is an observation made by Meckel, that it is not uncommon to find in some individuals cellular tissue substituted for certain portions of serous tissue. Thus, in situations where a synovial bursa is met with in one person, simple cellular tissue, containing a larger quantity of unctuous fluid than usual, is found in another. On the other hand, at more than one point, where commonly only cellular tissue exists, a serous cavity, more or less developed, is discovered. Thus, in consequence of long-continued friction between two parts, the intervening cellular tissue may be converted into the serous. When the integuments are subjected to protracted and repeated friction, the subcutaneous cellular tissue is transformed at the part into a synovial sac. In persons with club feet, Béclard found similar bursæ placed at the point where the skin suffers friction against the projecting bones of the tarsus. When a stump is examined, long after amputation, a serous cavity is frequently found beneath the skin, at the extremity of it. Sir Benjamin Brodie met with an instance of a bursa formed between the projecting part of a curved spine and the integuments, which at this point were continually gliding over the bony prominence. In examples of unreduced dislocations, the bones, in their new relation to one another, frequently require and receive a synovial or serous sac in the interspace between them, which sac, according to Andral, is formed at the expense of the cellular tissue; and the same thing happens in cases of fracture, where the bones continue united. (See *Andral, Précis, Anat. Pathol.* t. i. p. 243.)

Together with synovial bursæ, Sir Benjamin Brodie arranges the sheaths of tendons, as they have the same structure and perform a similar office. In the healthy state, the oily fluid formed by the synovial bursæ is so small in quantity, that it cannot be seen without opening the membrane containing it; but, occasionally, such an accumulation takes place, that very considerable swellings are the consequence. Tumours of this sort are often produced by bruises and sprains, and now and then by rheumatic affections. Sometimes they are not attended with much pain, though in other cases, when pressure is made with the fingers, it is rather acute. The tumours yield, in a certain degree, to pressure; but they rise again, with an elasticity, not remarked in other sorts of swellings. At first, they appear to be circumscribed, and confined to a small extent; but, sometimes, the fluid, forming them, is so abundant, that they extend over a great part of the circumference of the limb. The skin, when not inflamed, retains its usual colour.

In this morbid state of the bursæ mucosæ, they contain different kinds of fluids, according to the cause of the disease. When the tumour depends on a rheumatic affection, the contents are mostly thin; but thicker, when the cause is of a scrofulous nature. When the disease is the consequence of a bruise, or sprain, the effused fluid often contains hard concretions, and, as it were, cartilaginous ones, which are sometimes quite loose, and more or less numerous. I have had some cases, in which they corresponded to Sir Benjamin Brodie's description, in bearing some resemblance, in shape and size, to small melon seeds. This is not unusual when the tumour is of long standing. Such substances may occasionally be felt with the fingers; but, in general, when the swelling is old, the cyst is thick, and prevents them from being perceptible.

In the greater number of instances, inflammation of the bursæ mucosæ produces an increased secretion of synovia. In other cases, the bursa is distended with a somewhat turbid serum, containing floating portions of coagulable lymph. The inflammation sometimes leads to the formation of an abscess; and occasionally the membrane of the bursa becomes thickened, and converted into a gristly substance. Sir Benjamin Brodie has seen it at least half an inch in thickness, with a small cellular cavity in the centre containing synovia. In the North London Hospital, I lately saw a diseased bursa, equal in size to an orange, and the membrane of which was fully half an inch thick. The fluid within it contained numerous small bodies, of the size of melon seeds. In other instances, however, though the inflammation has lasted a considerable time, the membrane of the bursa retains nearly its original structure. (*Pathological and Surgical Obs. on the Joints*, p. 317. ed. 3.)

According to the same authority, the disease may be the consequence of pressure, or other local injury; the abuse of mercury; rheumatism, or other constitutional affection; and, in such cases, the complaint is frequently joined with inflammation of the synovial membrane of the joints. (See *Joints.*) Sometimes it has the form of an acute, but, more commonly, that of a chronic inflammation.

In the beginning, Sir Benjamin Brodie recommends the use of leeches and cold lotions, and afterwards that of blisters or stimulating liniments. In particular cases, he says, these means should be combined with such constitutional remedies as circumstances indicate. When the disease is of long standing, the preternatural secretion of fluid will often continue after the inflammation has entirely subsided. If blisters now fail in procuring its absorption, Sir Benjamin Brodie recommends friction; and, if this be unavailing, he considers it advisable to discharge the fluid by a puncture. The presence of loose substances in the bursa, he thinks, may of itself keep up a collection of fluid.

Dr. Monro met with cases in which the ill consequences of a puncture were such as to render amputation necessary. These he imputed to the air having access to the interior of the bursa. Hence it has been recommended to pass a seton through the swelling, and to remove the silk after it has remained just long enough to excite inflammation of the cyst, when an attempt is to be made to unite the opposite sides of the cavity by pressure.

This practice is sometimes approved of by Sir Benjamin Brodie on other grounds; he has noticed that, after the whole cavity of the bursa has been converted into an abscess, and this has been cured, no fluid generally collects again. Hence, he has sometimes been induced to pass into the puncture a seton, or tent, or (what he deems better) the blunt end of a probe, for the irritation of the inner surface of the bursa. This practice I tried very successfully on a young woman who was under my care. I punctured the bursa below the patella, and discharged about an ounce of fluid, resembling white of egg. The disease had existed several months, and the bursa was much thickened. I kept the puncture open about ten days, during which time there was a discharge from it of the same kind of fluid, without any tendency to suppuration. I therefore introduced a tent into the opening, by which means the necessary degree of inflammation was excited, the bursa suppurated, and the disease was soon permanently cured, without any severe symptoms. At the same time, I believe Sir Benjamin Brodie to be perfectly right in cautioning surgeons against the indiscriminate adoption of this practice. Inflammation and suppuration of a large bursa (he says) sometimes disturb the constitution so much, that it may be prudent merely to make a puncture, and keep the patient afterwards perfectly quiet. He mentions a diseased bursa mucosa, which he had seen between the lower angle of the scapula and the latissimus dorsi, and which was not much less than a man's head. In this case, death followed the constitutional disturbance excited by a puncture and a seton. In another example seen by this judicious surgeon, where the patient was in bad health, and the due observance of quietude was neglected, the puncture of a diseased bursa was followed by death. (*Op. cit.* p. 360.) In some instances, the making of an incision into a bursa mucosa has been followed by a fatal attack of phlegmonous erysipelas.

Mr. Mayo believes, that there is never occasion to lay an enlarged bursa extensively open, or to pass a seton through it, or to apply caustic. "If the fluid will not disperse by common means, it is only necessary to puncture the sac several times, when it will either cease to secrete an undue quantity of fluid, or suppurate, and thus get well." (See *Mayo's Outlines of Human Pathology*, p. 111.)

In the North London Hospital, I have had under my care numerous cases of diseased bursa. If inflamed, I find cold applications, leeches, and quietude the best means of relief. Afterwards a blister, or friction with ointment of hydriodate of potassa, or camphorated mercurial ointment. When the swelling suppurates, or resists these plans, I usually make an opening. A large one, which was under the care of Mr. Liston, and the sides of which were nearly three quarters of an inch thick, was successfully removed by means of the knife. It lay between the patella and the skin, and was easily taken out, after a crucial division of the integuments.

When the coats of a bursa are much thickened, and cannot be restored to their natural condition, if superficially situated, it may be removed with as much facility as an encysted tumour. This practice Sir Benjamin Brodie has only as yet applied to the bursa between the patella and the skin, though he entertains no doubt of there being other superficial bursa which would also safely admit of removal.

Consult *Monro*'s Description of all the Bursæ Mucosæ, &c., with remarks on their accidents and diseases, &c. fol. Edin. 1788. *C. M. Koch*, De Morbis Bursarum, tendinum mucosarum. Sir *B. C. Brodie*'s Pathological and

Surgical Obs. on the Joints, chap. 10. ed. 3. 8vo. Lond. 1834. *Herbert Mayo*'s Outlines of Human Pathology, p. 110. 8vo. Lond. 1835.

CÆSAREAN OPERATION. Called also *Hysterotomia*, from *ὑστέρα, uterus*, and *τομὴ, sectio.* Pliny, book vii. chap. 9. of his Natural History, gives us the etymology of it as follows: "*Auspicatiùs* (says he) *enectâ parente gignuntur, sicut Scipio Africanus prior natus, primusque Cæsar à cæso matris utero dictus; quâ de causâ cæsones appellati. Simili modo natus est Manlius qui Carthaginem cum exercitu intravit.*" Whether this explanation be correct, or not, it is now difficult to settle. According to Bayle, Aurelia, Cæsar's mother, was living at the period when that warrior invaded Britain, so that, if he were taken out of the womb by this proceeding, the life of the mother was also saved. Although the etymology and first practice of the Cæsarean operation are points involved in obscurity, its great antiquity is generally admitted; and this, notwithstanding no description of it is to be found in the works of Hippocrates, Celsus, Paulus Ægineta, or Albucasis. The earliest account of it in any medical work, is that in the Chirurgia Guidonis de Cauliaco, published about the middle of the fourteenth century. Here, however, the practice is only spoken of as proper after the death of the mother. (See *Cap. de Extractione Fœtus.* Vigo, who was born towards the close of the fifteenth century, takes no notice of the Cæsarean Operation; and Paré, who greatly improved the practice of midwifery, thinks this measure only allowable on women who die undelivered. (*De Hominis Generatione*, cap. 31.) Rousset, who was contemporary with Paré, collected the histories of several cases, in which the operation was successfully performed; and, after their publication, the subject excited more general interest.

By the *Cæsarean Operation* is commonly understood that in which the fœtus is taken out of the uterus, by an incision made through the parietes of the abdomen and womb. The term, however, in its most comprehensive sense, is applied to three different proceedings. It is sometimes employed to denote the incision, which is occasionally practised in the cervix uteri, in order to facilitate delivery; but this particular method is named the *Vaginal Cæsarean Operation*, for the purpose of distinguishing it from the former, which is frequently called, by way of contrast, the *Abdominal Cæsarean Operation.* With these cases, we have also to class the incision, which is made in the parietes of the abdomen, for the extraction of the fœtus, when, instead of being situated in the uterus, it lies in the cavity of the peritoneum, in consequence of the rupture of the womb, or in the ovary, or Fallopian tube, in consequence of an extra-uterine conception.

Vaginal Cæsarean Operation.

Disease, malformation, or a preternatural position of the cervix uteri, may render this practice indispensable. A fibro-cartilaginous hardness of the neck of the uterus is the most frequent cause. When the induration is such, that the cervix cannot be dilated, and the patient is exhausting herself with unavailing efforts, the parts should be divided in several directions. This has been successfully done under various circumstances. Cases have been met with, in which the cervix uteri presented no opening at all, and yet the preceding operation proved quite effectual. Such was the example which Dr. Simson inserted in the third vol. of the Edinb. Essays. A woman, forty years of age, became pregnant, after recovering from a difficult labour, in which the child had remained several days in the passage. She had been in labour sixty hours; but the neck of the womb had no tendency to dilate. Dr. Simson, perceiving that its edges were adherent, and left no opening betwixt them, determined to practise an incision, with the aid of a speculum uteri. The bistoury penetrated to the depth of half an inch before it got quite through the substance which it had to divide, and which seemed as hard as cartilage. As the opening did not dilate in the efforts which the woman made, it became necessary to introduce a narrow bistoury on the finger, in order to cut this kind of ring in various directions. There was no hemorrhage; and the only additional suffering which the patient encountered, arose from the distension of the vagina. As the child was dead, Dr. Simson perforated the head, in order to render delivery more easy.

Strong convulsions at the moment of parturition may create a necessity for the vaginal Cæsarean Operation. These sometimes subside, as soon as the membranes are ruptured, and the waters discharged, so as to lessen the distension of the womb. However, if the convulsions were to continue, and the cervix uteri were sufficiently dilated, the child should be extracted with the forceps, or by the feet, according to the kind of presentation. On this subject, Baudelocque has recorded a fact, which was communicated to the Academy of Surgery, by Dubocq, professor of surgery at Toulouse. A woman, forty years of age, had been in convulsions two days. She was alarmingly pale; her pulse feeble and almost extinct; and her extremities cold, and covered with a clammy perspiration. The edges of the opening, which was about as large as a crown piece, felt, as it were, callous; and hardly had this aperture been dilated, when delivery took place spontaneously. The child was dead. The symptoms were appeased, and the woman experienced a perfect recovery. Another case, in which the indurated cervix uteri was successfully divided, is recorded by Lambron, a surgeon at Orleans. (See *Dict. des Sciences Méd.* t. xxiii. p. 297.)

A considerable obliquity of the neck of the womb, combined with a pelvis of small dimensions, may also be a reason for the performance of the vaginal Cæsarean Operation. Not that such obliquity always occasions that of the rest of the uterus; nor is the neck of this viscus invariably directed towards that side of the pelvis which is opposite to its fundus, although this is sometimes the case. In the latter circumstance, as the contractions of the uterus do not produce a dilatation of its cervix, which rests upon the bones of the pelvis, the adjacent part of that organ is dilated and pushed from above downwards, so as to present itself in the form of a round smooth tumour without any appearance of an aperture. Such a case may have fatal consequences. Baudelocque furnishes us with an instance. A woman, in her first pregnancy, not being able to have the attendance of the accoucheur whom she wished, put herself under the care of a midwife, who let her continue in labour pains during three days. When the accoucheur came, on being sent for again, the child's head presented itself in the vagina, covered with the womb. The portion of the uterus, which included the fœtus, was in a state of inflammation. The os tincæ was situated backward, toward the sacrum, hardly dilated to the breadth of a penny piece, and the waters had been discharged a long time. The patient was bled, and emollient clysters and fomentations were employed. She was laid upon her back, with her pelvis considerably raised. The accoucheur had much difficulty in supporting the head of the child, and keeping it from protruding at the vulva, enveloped, as it was, in the uterus. Notwithstanding such assistance the patient died.

So fatal an event, says Sabatier, might have been prevented, by making the woman lie upon the side, opposite the deviation of the uterus, and employing pressure from above. If these proceedings had failed in bringing the os tincæ toward the centre of the pelvis, this opening might have been brought into such position, by means of the finger, in the interval of the pains, and kept so, until it were sufficiently dilated for the membranes to protrude. This is what was done by Baudelocque in one case, where the womb inclined forward and to the right.

When the obliquity of the uterus is such, that the os tincæ cannot be found, and the mother and fœtus are both in danger of perishing, it is the duty of the practitioner to open the portion of the womb that projects towards the vulva. Lauverjat met with a case of this description. A woman, pregnant with her first child, suffered such extreme pain in her labour, that Lauverjat was solicitous to ascertain the real state of things. He was surprised to find the vulva completely occupied by a body, which even protruded externally, and yielded to the pressure of the fingers, except during the labour-pains. In examining this tumour, he could only find at its circumference a cul-de-sac, half an inch deep, without any aperture through which the child could pass. Other practitioners, who were consulted about this extraordinary case, were also anxious to learn what had happened. They found in the tumour a laceration, which only affected a part of the thickness of its parietes. This laceration was deemed the proper place for making an incision. The operation having been done, the finger was passed into the cavity, in which the child was contained. A large quantity of turbid fluid was discharged. The child presented, and passed through the opening, with a trivial laceration on the right side. Lauverjat, having passed his hand into the uterus, was unable to find either the os tincæ, or the cervix. No particular indisposition ensued, and the lochia were discharged through the wound, which gradually closed. In the course of two months, the os tincæ and neck of the uterus were in their natural position again. (*Lauverjat, Nouvelle Méthode de pratiquer l' Operation Césarienne.* Paris, 1788.)

When the case is a fibro-cartilaginous induration of the cervix uteri, or a laceration of the parietes of this viscus, at the place where it projects into the vagina, the vaginal Cæsarean Operation is attended with no difficulty. It is performed with a probe-pointed bistoury, the blade of which is wrapped round with lint, to within an inch of the point. The instrument is introduced, under the guidance of the index finger, into the opening presented by the uterus, and the aperture is enlarged, from within outwards, in various directions. But, when the hardness of the cervix presents no opening at all, or when the part of the uterus projecting in the vagina is entire, the incision should be made from without inwards, with the same kind of knife. Too much caution cannot be used in introducing the instrument, in order that no injury may be done to the child. No general direction can here be offered, except that of proceeding slowly, and of keeping the index finger extended along the back of the knife, so that it may be immediately known when the substance of the womb is cut through, into the cavity of which the finger ought to pass as soon as the knife. If it should be necessary to extend, or multiply the incisions, the cutting instrument should be regulated in a similar manner, with the same finger. The cervix uteri having been divided, the expulsion of the child is either to be left to nature or promoted by ordinary means. The wounds require no dressings. If the bleeding should prove troublesome, we are recommended to apply to the incision a dossil of lint, dipped in spirit of wine. (See *Sabatier, Méd. Opératoire,* t. i.) The chief object would here be to prevent adhesions, between the cervix of the uterus and the upper part of the vagina. (*Dict. des Sciences Méd*. t. xxiii. p. 298.)

Abdominal Cæsarean Operation.

This is a far more serious operation than that which has just now been treated of, and is the proceeding, to which the term Cæsarean Operation is more particularly applied. There are three cases, in which it may be necessary. 1. When the fœtus is alive, and the mother dead, either in labour, or the last two months of pregnancy. 2. When the fœtus is dead, but cannot be delivered in the usual way, on account of the deformity of the mother, or the disproportionate size of the child. 3. When both the mother and child are living, but delivery cannot take place fron the same causes, as in the second example.

In many instances, both mother and child have lived after the Cæsarean Operation, and the mother even borne children afterwards. (See *Heister's Institutes of Surgery*, chap. cxiii. *Mém. de l' Acad. de Chirurgie*, t. i. p. 623; t. ii. p. 308. in 4to. *Edin. Med. Essays*, vol. v. art. 37, 38. *Edin. Med. and Surgical Journal*, vol. iv. p. 179. *Med. Chir. Trans.* vol. ix. and xi., &c.) Dr. Müller, of Lowenburg, in Silesia, performed the Cæsarean section, and saved both the mother and the child. (*Magazin für die gasammte Heilkunde*, 1828; b. 28. p. 146.) An instance of similar success is reported by C. H. Graefe. (*Journal für Chirurgie, &c.* b. 9. s. i.) Two cases occurred in which both women and children were saved, at the hospital of Maestricht, by M. Bosch. (*Bibl. Med.* 1823.) And in a valuable periodical work one example is reported from Hufeland's Journal, where the mother and twins were all saved by the operation. (See *Quarterly Journ. of Foreign Medicine, &c.*, vol. iv. p. 625.)

The most extraordinary case of Cæsarean Operation on record, is one performed by a negro-girl on herself, who recovered. (See *New York Med. and Physical Journ.* March, 1823.) Dr. Mosely mentions the case of a negro-woman at Jamaica, who opened her side with a butcher's knife, and extracted a child, which died of locked jaw. The woman recovered. (See *Ryan's Manual of Midwifery*, p. 280.)

In England, the operation has been attended with remarkably ill success; and there is scarcely one unequivocal example, in which the mother has here survived the true Cæsarean Operation. In the third edition of this work, indeed, I referred to the case recorded by Mr. James Barlow, of Chorley, Lancashire, who made an incision into the abdomen, extracted a dead child, and saved the mother's life. (See *Medical Records and Researches*, p. 154, 1798; also *J. Barlow's Essays on Surgery and Midwifery*.) My friend, the late Dr. Gooch, however, having obligingly communicated to me his doubts, and those of Dr. Hull, respecting the reality of an incision having been made in this instance into the uterus, I am glad to have the opportunity of expressing my perfect conviction of the more correct view of the case, taken by these physicians. "I suspected from the first (says Dr. Hull), that Mr. Barlow was deceived in this case, from the account he gave of the *remarkable thinness of the uterus*. And I had formed an opinion, that the *child had escaped through a laceration of the uterus into the abdomen*, enveloped in the secundines, and that he had merely divided the membranes, when he fancied that he had divided the uterus. Dr. Hull then proceeds to explain the confirmation of his own sentiments by those of Mr. Howarden, a very intelligent practitioner at Blackrod, who assisted at the operation. In fact, the particulars stated by this gentleman leave no doubt, that the fœtus had escaped through a laceration of the uterus into the cavity of the abdomen. (See *Hull's Defence of the Cæsarean Operation, &c.* p. 72.) The case also referred to by Mr. D. Stewart (see *Edin. Med. Essays*, vol. v.), where the labour had endured twelve days, and the life of the mother was saved, after the dead fœtus had been extracted by a midwife, was also probably of the same nature: at all events, the want of authentic particulars, and the circumstance of the operation having been done by a woman, leave the true nature of the case questionable.

If, therefore, when we speak of the Cæsarean Operation, we mean that in which the parietes of the abdomen and those of the uterus are divided by the surgeon, and the fœtus extracted, I believe that, with, perhaps, only one exception, under Mr. Knowles, of Birmingham, so far as the history of the practice extends in this country, it cannot be said that the mother has ever recovered after such a proceeding. Some years ago, a calculation was made, that the operation had been done not less than eighteen times in Great Britain; and since then, it has been repeated with nearly the same ill success. (See *Henderson's Case, in Ed. Med. and Surg. Jour.* vol. 17.) It is said now, indeed, to have been performed about thirty times in the British dominions. (See *Ryan's Manual of Midwifery*, p. 270.) Several of the children, however, were saved. Thus in the case operated upon in April, 1826, by Mr. Crichton, of Dundee, the infant was preserved, though the mother sunk eight hours after the operation. (See *Edin. Med. and Surg. Journ.* No. 96. p. 54). Mr. Crosse has lately adverted to some recent instances, in which the Cæsarean Operation was performed "in a majority of the conditions, which may demand it; for narrow pelvis; tumours in the uterus, or vagina; extra-uterine conception; rupture of the uterus; and sudden death from apoplexy and other causes. The operation (says he) has also been performed, and with success, in the leading countries of the world. In England, we have a single and most critical example of its success by Mr. Knowles, of Birmingham; and, in America, Professor Gibson, has been the first to save the life of both patient and child by this intrepid proceeding. The most frequent examples are to be found in the publications of France and Germany; and I have grounds for stating, that, on some occasions, the operation has been resorted to, where there seemed to be scarcely a hope of any good result; or determined on when not absolutely called for; or neglected still more often, where obviously applicable, not only because calculated to avoid protracted suffering, but to afford a chance of saving life. Rupture of the uterus seldom calls for ventro-section. Amongst the numerous cases of this accident, no less than thirty-four, related by Dr. Collins, there is scarcely one, in which the operation could have been undertaken with propriety. The recovery of two patients, after rupture of the uterus in Dr. Collin's practice, and, under the most unpromising conditions, should impress the lesson of not despairing on the occurrence of so formidable an accident." (See *J. G. Crosse in Prov. Med. and Surg. Trans.* vol. v.)

On the Continent, the practice has proved infinitely more successful; for, of 231 cases of this operation to be found in the records of medicine, 139 are said to have terminated successfully. (*Kellie, in Edin. Med. and Surg. Journ.* vol. viii. p. 17.) No doubt, the ill success of the Cæsarean Operation in England was correctly explained by Dr. Hull:—"In France, and some other nations upon the European continent, the Cæsarean Operation has been, and continues to be, performed, where British practitioners do not think it indicated; it is also had recourse to early, before the strength of the mother has been exhausted by the long continuance and frequent repetition of tormenting, though unavailing pains, and before her life is endangered by the accession of inflammation of the abdominal cavity. From this view of the matter, we may reasonably expect, that recoveries will be more frequent in France, than in England and Scotland, where the reverse practice obtains. And, it is from such cases as these, in which it is employed in France, that the value of the operation ought to be appreciated. Who would be sanguine in his expectation of a recovery under such circumstances, as it has generally been resorted to in this country, namely, where the female has laboured for years under *malacosteon* (*mollities ossium*), a disease hitherto in itself incurable; where she has been brought into imminent danger by previous inflammation of the intestines, or other contents of the abdominal cavity; or been exhausted by a labour of a week's continuance, or even longer?" Dr. Hull thus refutes the opinion of Mr. W. Simmons, that our ill success was owing to climate, or some peculiarity in the constitution of the females of this island. (See *Hull's Defence of the Cæsarean Operation*, p. 10.)

M. Velpeau considers it easy to prevent the fluid of the amnios and blood from being effused in the peritoneum; and inclines to the views entertained by Dr. Hull, of the causes of the Cæsarean Operation having proved so frequently fatal. (See *Nouv. Elem. de Méd. Opér.* t. iii. p. 678.)

The general readiness of continental practitioners to have recourse to the Cæsarean section, has been sometimes censured, because they have even operated in cases, in which the patients had previously borne children in the natural way. According to Dr. Ryan, however, there are but four such cases on record : — " One by Nagele, in his *Erfahrungen und Abhandl. aus dem Gebiete des Krankheiten des Weiblichen Geschlechts ;* another by Henderson, in the *Edin. Med. and Surg. Journ.* No. 66. ; a third by Meier, in *Siebold's Journ. ;* and a fourth in the same Journ. by Bergen." (See *Ryan's Manual of Midwifery*, p. 279.) Certainly, if a woman had already borne children in the natural way, the fact should be received as a strong argument against the necessity of the operation, but perhaps not as an absolute prohibition, since every thing must depend on the actual dimensions of the lower aperture of the pelvis, in relation to the size of the existing fœtus.

When the fœtus is contained in the womb, and cannot be expelled, by reason of the invincible obstacles to which I have already referred, and embryotomy, or the practice of sacrificing the fœtus and extracting it piecemeal by the vagina, be deemed improper, the Cæsarean Operation should be practised, before the mother and fœtus both perish from the violence of the pains, hemorrhage, convulsions, &c.

For this purpose, it is necessary to make an extensive incision in the integuments of the abdomen, and in the uterus. Some have thought, that cutting the parietes of the belly would be mortal, while others have believed a wound of the uterus equally dangerous. Hence, such persons have condemned the operation on the principle, that religious reasons do not authorise taking one life to save another. All the opponents of the Cæsarean Operation fear the hemorrhage, which, they say, must follow. Indeed, if the uterus were not to contract sufficiently, when the fœtus and afterbirth had come away, the bleeding would really be perilous. But when the fœtus is extracted, together with the placenta and membranes, the uterus contracts, just as it does after a natural labour. Besides, even when the mother is alive, the operation is not commonly done, till the uterus evinces a propensity to deliver itself, and begins to contract. The womb being delivered of its contents, the incision becomes closed, the vessels obliterated, and there is no fear of hemorrhage. The wound must also make so irritable an organ more disposed to contract ; but, whatever arguments may be adduced, it is enough to say in this case : *Artem experientia fecit, exemplo monstrante viam.* Rousset, in 1581, published a work, in French, entitled, *Hystérotomie, ou l'Accouchement Césarien.* This book, in 1601, was translated into Latin, and enlarged with an appendix by the celebrated Bauhin. Even then, the practice of the Cæsarean Operation on the living mother had its defenders. Bauhin relates that, in the year 1500, a sow-gelder performed the Cæsarean Operation on his wife, *tam feliciter, ut ea posteà gemellos et quatuor adhuc infantes enixa fuerit.*

The possibility of operating successfully on the living mother, was proved with great perspicuity and accuracy by Simon. (See *Mémoires de l'Acad. de Chirurgie*, t. i. 4to.) Here is a collection of sixty-four Cæsarean Operations, more than a half of which had been done on thirteen women. Some of these had undergone the operation once or twice ; others five or six times. One woman in particular underwent it seven times with success. But, if the life of the mother should not invariably be preserved, the Cæsarean Operation ought not to be rejected on this account ; it ought always to be done, when relief cannot be obtained by other means ; just as amputation and lithotomy are practised, though they are not constantly followed by success. Would any thing be more cruel, than to abandon a mother and her child, and leave them to perish, while there is any hope of saving them both? It is true, that, when a pregnant woman dies of any inward disorder, and not from the pains, and efforts of labour, the fœtus is sometimes still alive in the uterus ; but, in cases of death, after difficult labours, and the great efforts made by the uterus to overcome the obstacles to parturition, the fœtus is generally dead ; and the operation therefore is less likely to be availing. (See *Bertrandi, Traité des Opérations de Chirurgie,* chap. v.)

It is the opinion of the best writers upon this subject, that, whenever a woman dies, far advanced in pregnancy, the performance of the Cæsarean Operation is highly proper. The propriety of this practice, in such circumstances, was known to the ancient Romans ; for, by a decree of Numa Pompilius, no woman who died pregnant was suffered to be buried ere her body had been opened, with the view of preserving the infant for the use of the state. (*Sprengel, Geschichte der Chir.* th. i. p. 371.) Experience has proved, that when the fœtus has not attained the period at which parturition commonly happens, it will sometimes survive the operation a considerable time, and that, when it is full grown, its life may be most happily preserved. Although instances are cited, in which the fœtus in utero has been found alive upwards of four-and-twenty hours after the death of the mother, little stress should be laid on such prodigies. The operation ought to be done without any delay. Even then, we are not certain of saving the infant's life. In the greater number of instances, the fœtus perishes at the same time with the mother, and from the same causes. The cases, which are recorded, of the fœtus being extracted alive, after the death of the mother, are numerous : I shall here only refer to three, two of which rest on the unimpeachable authority of Flajani, who was himself the operator. (*Osservazioni, &c. di Chirurgia,* t. iii. p. 144—146.) In one of these instances, the operation was done on a woman, killed by violence, in the ninth month of pregnancy ; the child lived six hours : in the other, a fœtus was extracted from a woman who had died of typhus fever, in the seventh month, and though the operation was not done till she had been dead about an hour, the child was taken out alive, and continued to live full ten minutes. A living child was also taken out of its mother by Vesling, after her death from typhus. (*Welsch. Obs. Med. Episagm.* No. 74. p. 47 ; *Sprengel, Geschichte der Chir.* th. i. p. 374.) On the 15th of April, 1820, Mr. Green, of St. Thomas's Hospital, extracted by the Cæsarean Operation, from a woman suddenly killed in the ninth month of pregnancy by the passage of a stage coach over her, a fœtus that lived thirty-four hours after its removal from the uterus. (See *Med. Chir. Trans.* vol. xii. p. 46.) With respect to the statements of Cangiamila, a Sicilian practitioner, I join Sprengel in considering them as incredible exaggerations : five instances are given, in which the fœtus was taken out of the mother from fifteen to twenty-four hours after her death, and yet it continued to live. Cangiamila says, that at Syracuse, in the course of eighteen years, the operation had been practised twenty times under the same circumstances; that at Girgenti, thirteen children were saved out of twenty-two women, who had died pregnant; and that, in twenty-four years, at Montereali, twenty-one children were preserved in the same manner. (*Embryologia Sacra. Venet.* 1763, fol.) As Sprengel remarks, one might almost suppose, from this account, that in Sicily pregnancy was generally fatal. If the mother should happen to die in labour, and the neck of the uterus were sufficiently dilated, or disposed to be so, an attempt should be made to accomplish delivery in the ordinary way; for examples have occurred, in which women, supposed to be dead in this circumstance, were in reality alive. Hence, we find, that the senate of Venice, in 1608, enacted a law, by which practitioners were liable to punishment, in case they neglected to operate with as much caution on a pregnant woman, supposed to be dead, as on the living subject; and rules to be observed were again issued by the same government, in 1720. (*Sev. Melli, La Commare levatrice*, p. 108. 4to. *Venez.* 1721; *Personè, Diss. sopra l'Operaz. Cesar.* p. 15. 8vo. *Venez.* 1778.) A law to the same effect was likewise made in 1749, by the king of Sicily, who decreed the punishment of death to those medical men who omitted to perform the Cæsarean Operation on such women as died in the advanced stages of pregnancy. The following case, confirming the propriety of such caution, was recorded by Rigaudeaux, surgeon to the Military Hospital at Douay. This practitioner having been sent for to a woman, to whose residence he was unable to proceed till two hours after her apparent death, he had the sheet, with which she was covered, removed, and perceiving that the body retained its suppleness and warmth, he tried whether the fœtus could not be extracted in the ordinary way, which was easily effected as soon as the feet were got hold of. The first endeavours to save the child, were very unpromising; but, after a few hours, they had the desired effect. As the woman continued in the same state, five hours afterwards, Rigaudeaux recommended that she might not be buried, before her limbs were quite cold and stiff. He afterwards had the satisfaction to learn, that she was also restored to life. This remarkable case happened on the 8th of June, 1745, and both the mother and child were living at the period when Rigaudeaux published. (See *Journ. de Savans, An.* 1749.)

Almost all the insurmountable obstacles to delivery originate from the bad conformation of the pelvis, depending upon rachitis; though they are not an invariable consequence of it, since there are women, extremely deformed, in whom no imperfection of the pelvis exists, while it prevails in others, whose shape is but trivially disfigured. An examination of the dimensions of the pelvis is the right mode of ascertaining whether there is really such an impediment to parturition. In order that the dimensions may not be an obstacle to delivery, the distance between the upper edge of the sacrum and the os pubis ought to be three inches and a half; and the distances between the tuberosities of the ischium, and between each of these protuberances and the point of the os coccygis, three inches. Women have indeed been known to be delivered, without assistance, although the first of the above distances was only two inches and a half; but then the heads of the children were so elongated, that the great diameter was nearly eight inches, while that which extends from one parietal protuberance to the other, was reduced to two inches five or six lines, and the infants were lifeless. If they are to be born alive, they must be taken out of the womb by the Cæsarean Operation; but the latter proceeding should never be adopted, without a certainty that they are actually living; for when dead, they may be extracted in a way that is attended with much less risk to the mother.

It is not always an easy matter to ascertain, with certainty, whether a fœtus in utero be living or dead. If it has entirely ceased to move, after being affected with a violent motion, the probability is, that it is no longer alive. But, to be certain, the auscultation with the stethoscope, or a manual examination is necessary, which may be practised in two ways. One consists in pressing upon the uterus, through the parietes of the abdomen. If the child lives, such pressure makes it move, and the motion can be plainly felt, and distinguished. In the other method, one hand is employed in pressing upon the uterus externally, while, with the fingers of the other hand, passed up the vagina, corresponding pressure is also to be made. The uterus is likewise to be allowed to descend as far as possible, in order to induce the fœtus to move. When no decisive indications can be thus obtained, it becomes necessary to rupture the membranes, if they have not already given way, introduce the hand into the uterus, and put a finger into the child's mouth, for the purpose of making it move its tongue. The finger may also be applied to the region of the heart, so as to examine, whether this organ is beating; and the umbilical cord may be touched, in order to ascertain, whether there is still a pulsation in it. When none of these proceedings furnish unequivocal information, the conclusion is, that the child is dead, and its extraction is indicated, unless the narrowness of the parts be such, that the hand cannot be passed into the uterus, in which case the Cæsarean Operation is indispensable.

But how are we to form a judgment respecting the dimensions of the pelvis? And how can we know, whether that diameter, which extends from the prominence of the sacrum to the os pubis, is long enough to allow the passage of the child? The proper conformation of this part is known by the roundness and equality of the hips, both in the transverse and perpendicular direction; by the projection of the pubes; by the moderate depression of the sacrum; by an extent of four or five inches from the middle of this depression to the bottom of the os coccygis; by an extent of seven or eight inches from the spinous process of the last lumbar vertebra to the highest part of the mons veneris, in a woman moderately fat; and by there being an interspace of eight or nine inches, between the two anterior superior spinous processes of the ossa ilium.

These general calculations, however, are insufficient. In order to acquire more correct opinions, double compasses have been employed. The branches of the first being applied to the top of the sacrum, and middle of the mons veneris, three inches are to be deducted from the dimensions indicated by the instrument; viz. two inches and a half for the thickness of the upper part of the sacrum (which is said to be constant in subjects of every size), and half an inch for that of the os pubis. In women who are exceedingly fat, some lines must also be deducted on this account. Hence, when the total thickness of the pelvis, measured in this direction, is seven inches, there will remain four for the distance from the upper part of the sacrum to the os pubis, or for the extent of the lesser diameter of the upper aperture of the pelvis.

For taking the measurement internally, a kind of sector was invented by Coutouly. It bears a considerable resemblance to the instruments employed by shoemakers for measuring the feet. It is passed into the vagina, with its two branches approximated, until one arrives opposite the anterior and upper part of the sacrum, when the other is to be drawn outward, so as to be applied to the pubes. The distance between the branches is judged of by the graduations on the instrument. This was named by its inventor a pelvimeter. According to Sabatier, it is not always easy to place it with accuracy; its employment is attended with some pain; and there are particular cases in which it cannot be used.

Instead of this contrivance, Baudelocque recommended a means, which is safe and simple. The index finger of one hand is introduced into the vagina to the upper part of the projection of the sacrum. The finger, having the radial edge turned forwards, is then to be inclined anteriorly till it touches the arch of the pubes. The point of contact being then marked with the opposite hand, the length from the point in question to the end of the finger is to be measured. This length, which indicates the distance between the sacrum and the bottom of the symphysis pubis, usually exceeds that of the lesser diameter of the pelvis by about six lines. Baudelocque acknowledges that this measurement is not exactly accurate; but he believes it to be sufficiently so, because, unless the narrowness of the pelvis be extreme, two or three lines hardly make any difference in the facility of parturition.

The following is the description of the pelvis of the woman, twice operated upon by Dr. Locher: the ossa pubis, which should be on the same level with the promontory of the sacrum, were found perpendicularly under it; so that the child necessarily extended the abdominal integuments by its own weight, into a pendulous bag overhanging the thighs. For the same reason, nothing could be felt of the child by examination per vaginam. The sacrum, instead of closing the pelvis behind, by a semicircular curve, which forms a kind of conductor for the child in parturition, stretched nearly horizontally backwards. A representation of this pelvis, with a few other particulars, may be seen in a modern publication. (*Med. Chir. Trans.* vol. xi. p. 199.)

The pelvis may be everywhere well formed, and yet present an insurmountable obstacle to delivery. This may happen when an exostosis exists on one of the bones which compose this part of the skeleton. Pineau met with a case of this description in a woman who died undelivered. The tumour originated from one of the ossa pubis. A steatomatous swelling, situated with the head of the child in the upper aperture of the pelvis, might produce the same effect, unless it were detected, and could be pushed out of the way, so as to make room for the fœtus to pass. Baudelocque mentions a swelling of this kind. It was six or seven inches long, and an inch and a half in width. The extremity of it, which was as large as half a hen's egg, had a bony feel, and contained nine well-formed teeth, the rest of the mass being steatomatous. It had descended into the lesser pelvis below the projection of the sacrum, and a little to one side. It might have been taken for an exostosis of this last bone. The labour-pains continued sixty hours, and the propriety of performing the Cæsarean Operation was under consideration. Baudelocque was averse to this proceeding. He recommended turning the child, and extracting it by the feet, because he thought that the pelvis was sufficiently capacious to admit of delivery. The event proved that it was three inches nine lines from before backward, and four inches nine lines transversely. The fœtus was soon extracted with the assistance of forceps. The child was still-born. The mother, exhausted with numerous unavailing efforts, only survived between fifty and sixty hours.

Among the insurmountable obstacles to delivery may be reckoned such a displacement of the uterus, that it protrudes from the abdomen, and forms a hernia. The records of surgery contain some examples of this extraordinary occurrence. Twice has the Cæsarean Operation been performed, and, in one of the cases, the woman survived so long, that hopes were entertained of her recovery. Indeed, as Sabatier observes, why should not the operation succeed in such a case, where the uterus is only covered by the integuments, and there is no occasion to cut into the abdomen, just as well as in other instances, in which it is indispensable to divide the muscles, and open the cavity of the belly? In the other case on record, delivery was effected in the ordinary way, either by raising the abdomen, and keeping it in this position with towels skilfully placed, or by making pressure on the uterus, which had the beneficial effect of making this organ resume its proper situation.

Having shown the absolute necessity for the Cæsarean Operation, under certain circumstances, it remains to consider the proper time for performing it, the requisite preparatory means, and the method of operating.

With regard to the time of operating, practitioners do not agree upon this point: some advising the operation to be done before the membranes have burst, and the waters been discharged; others, not till afterwards. The arguments in favour of the first plan, are, the facility with which the uterus may be opened without any risk of injuring the fœtus, and the hope that the organ will contract with sufficient force to prevent hemorrhage. The advocates for the second mode believe, that, in operating after the discharge of the waters, there is less danger of the uterus falling into a state of relaxation, in consequence of becoming suddenly empty after being fully distended, and that this method does not demand so extensive an incision. Hence they recommend, as a preliminary step, the membranes to be opened. Whatever conduct be adopted, it is essential that the labour should be urgent and unequivocal, that the cervix uteri should be effaced, and that the os tincæ should be sufficiently dilated to allow the lochia to be discharged; but, at the same time, says Sabatier, if the operation is not to be done till after the escape of the waters, there ought not to be too much delay, lest the patient's strength should be exhausted, and the violent efforts of labour should bring on an inflammatory state of the parietes of the uterus.

The propriety of emptying the rectum and bladder is so evident, that it is unnecessary to insist upon it. This precaution is more particularly requisite in regard to the latter of these viscera, which has been known to rise so much over the uterus as to conceal the greater part of it. Baudelocque had occasion to remark this circumstance in a woman upon whom he was operating. The bladder ascended above the navel, and presented itself through the whole extent of the opening made in the parietes of the abdomen.

The instruments, dressings, &c. which may be wanted, are two bistouries, one with a convex edge, the other with a probe-point; sponges, basins of cold water; long strips of adhesive plaster; needles and ligatures; lint; long and square compresses; a bandage to be applied round the body, with a scapulary, &c.

For the purpose of undergoing the operation, the patient should be placed at the edge of her bed, well supported; her chest and head should be moderately raised; her knees should be somewhat bent, and held by assistants, one of whom ought to be expressly appointed to fix the uterus by making pressure laterally, and from above downward, so as to circumscribe, in some degree, the swelling of the uterus, and prevent the protrusion of the bowels. These things being attended to, the integuments are to be divided with the convex-edged bistoury to the extent of at least six inches. The place and direction of this incision differ with different operators.

In the most ancient method, it was customary to make the incision between the outer edge of the rectus muscle, and a line, drawn from the anterior superior spinous process of the ilium, to the junction of the bone of the first rib with its cartilage. This cut was begun a little below the umbilicus, and was continued downward to an inch above the pubes. After the integuments had been divided, the muscles, aponeuroses, and peritoneum were cut, and the uterus cautiously opened. The left index finger was then introduced into this viscus, the wound of which was dilated by means of a probe-pointed bistoury.

This manner of operating is subject to great inconveniences. The place where the incision is made, is the situation of muscles, the fibres of which have a different direction, and, on contracting, separate the edges of the wound, and make it gape. The considerable blood-vessels, which ramify there may be the source of perilous bleeding. The bowels can protrude in that situation more readily than any where else. When the position of the uterus is oblique, and when, consequently, its edges are turned forward and backward, and its surfaces to the right and left, the incision will be made in one of its lateral portions where the trunks of its blood-vessels are known to be situated, and even the Fallopian tube and ovary may be cut. The fibres of the uterus are cut transversely, so that the edges of the incision gape, instead of being in contact. This last circumstance may the more readily permit the lochia to escape into the abdomen, inasmuch as the uterus is cut nearly through its whole length, and there is no cavity, in which they can accumulate, in order to be discharged through the cervix of that organ.

The linea alba has been frequently considered the most eligible place for making the incision. It was the method adopted by Soleyrès and Deleurye, and it had the recommendation of Baudelocque, because there are fewer parts to be cut, and when the uterus is exposed, an incision, parallel to its principal fibres, may be made in its middle part. The method was known to Mauriceau, as we may be convinced of by the following passage, extracted from the chapter in which he treats of the Cæsarean Operation: "*La plupart veulent qu'on incise au côté gauche du ventre; mais l'ouverture sera mieux au milieu entre les muscles droits, car il n'y a en ce lieu, que les tégumens et les muscles à couper.*" Lauverjat, who has made this remark, and cited the Latin edition of Mauriceau, page 247, also observes, that the incision in the linea alba was practised by a contemporary of La Motte, a circumstance which Sabatier was not able to ascertain. (*Méd. Opér.* t. i.) The following is the proper manner of operating in the linea alba. The bladder is to be previously emptied. The operator should first divide the integuments perpendicularly, so as to expose the linea alba, making the wound six or seven inches long. An opening should then be carefully made through the aponeurosis, fascia transversalis, and peritoneum, into the abdomen, either at the upper or lower part of the linea alba in view. A curved bistoury is then to be introduced into the opening, and the peritoneum, fascia transversalis, and linea alba cut from within outward, as far as the extent of the wound in the integuments. The latter cut should be cautiously made, with the crooked bistoury, guided by the forefinger of the left hand, lest any of the intestines be accidentally injured. The uterus must next be carefully opened, and an incision made in it, of the same length as the preceding wound. The fœtus is to be taken out through the wound, and then the placenta and membranes. In this way, M. Artiste lately operated, so as to save both mother and child. (See *Edin. Med. and Surg. Journ.* vol. iv. p. 178.

In this country (where, indeed, the Cæsarean Operation has proved most unsuccessful) the linea alba is preferred, I believe, by the majority of practitioners. That the method is not always attended with the formidable objections urged against it by Sabatier, is quite certain; the case published by Dr. Chisholm, is a decisive proof of this assertion. (See *Edin. Med. and Surg. Journ.* vol. iv. p. 178, 179.)

A third method of performing the abdominal Cæsarean Operation, consists in making a transverse incision, five inches in length, through the parietes of the abdomen, between the rectus muscle and the spine, and in a situation more or less high, according to the more or less elevated position of the uterus. This plan was recommended by Lauverjat. (See *Nouvelle Méthode de pratiquer l'Opération Césarienne.* Paris, 8vo. 1788.) Lauverjat acknowledges, that the method had been successfully practised by different persons before himself, and especially in one instance, which was particularly remarkable, as, in consequence of the first incision having been made too high up, it became necessary to make a second one, which extended obliquely from the other.

The side, on which the operation is to be done, is in itself a matter of indifference. But, if the liver or spleen were to project, one ought to avoid it. Also, if the uterus were to incline more towards one side than the other, it would be proper to operate on the side where this viscus could be most conveniently exposed. The patient being put in a proper position, and her abdomen kept steady by an attendant, who must apply the palms of his hands to the sides of the uterus, the integuments, muscles, and peritoneum are to be divided with the usual precautions. The uterus is then to be opened, and the wound in it enlarged in the requisite degree, by means of a probe-pointed bistoury. Should the placenta present itself, care must be taken not to injure it; but it should be separated, in order to facilitate breaking the membranes at its circumference. The child is next to be extracted. This part of the operation is subject to no general rule. Delivery being accomplished, we are recommended to introduce through the vagina anodyne injections, in order to lessen spasm, and wash out the coagula. This method is preferable to that of clearing out the uterus with the hand. Sabatier condemns the plan, formerly advised by Rousset and Ruleau, of passing a catheter up the neck of this viscus for the purpose of washing out the lochia, as well as the absurd proposal of employing a seton to promote their escape. Should the lochia not pass readily outward, we are recommended to introduce the finger occasionally into the cervix uteri, so as to free it from coagula.

The only dressings, advised by Sabatier, are a large pledget, compresses, and a moderately tight bandage round the body. These are to be changed when soiled with the matter or discharge. In this country, practitioners would not neglect to bring the edges of the wound together, by means of strips of adhesive plaster; for, though they may not act with so much effect in this situation as many others, they undoubtedly assist in promoting one chief aim of the surgeon, which is to heal at least all the upper part of the incision, if possible, by the first intention. I have no doubt, also, that there are many who would be advocates for sutures.

Mr. Wood, of Manchester, performed the Cæsarean Operation, in a case where parturition was prevented by deformity of the pelvis. The incision was made nearly in a transverse direction, on the left side of the abdomen, about five inches in length, beginning at the umbilicus. This part was fixed upon, because the nates of the child could be felt there, and it was evident, that no intestine was interposed betwixt the abdominal parietes and the uterus. There was scarcely any effusion of blood, either from the external wound, or from that of the uterus, though the latter was made directly upon the placenta. Instead of dividing the placenta, Mr. Wood introduced his hand betwixt it and the uterus, and, laying hold of one of the knees, extracted the fœtus with ease. His hand readily passed betwixt the placenta and uterus; this produced hemorrhage; but the whole quantity of blood lost did not exceed seven or eight ounces. After the uterus had been emptied, the intestines and omentum protruded at the wound. These having been reduced, the integuments were brought into contact with sutures and adhesive plaster. This operation, however, did not save the woman's life; she died on the fourth day after its performance. (See *Med, and Physical Journ.* vol. vi.)

In this Dictionary, I do not deem it necessary to enter into other plans of performing the Cæsarean Operation, without opening the peritoneum, or wounding the body of the uterus. The methods of Ritgen, Baudelocque, the nephew, and Dr. Physic, are all described by Velpeau, but only to be disapproved of. (See *Nouv. Elem. de Med. Opér.* t. iii. p. 682., &c.)

As I have already explained, the ill success of the Cæsarean Operation in England has been such, that only a single case has yet happened in which the life of the mother has been preserved after the child was certainly extracted from the womb by incision. The probable reason of this circumstance I have also noticed. Abroad, however, the success of the practice forms quite a contrast to what has occurred in this country, the operation having been often done so as to save the lives both of the mother and child, of which an interesting example was recently published by Dr. Locher, of Zurich. (See *Med. Chir. Trans.* vol. ix. p. 11.) And in vol. xi. of the same work, may be read a case, in which Dr. Meyer, of Minden, saved a woman by the operation, but the fœtus was dead: we have also an example, in which Dr. Spitzbarth, in 1819, preserved the lives both of the infant and mother, and another interesting relation of two Cæsarean Operations performed by Lorinser, on a woman still living at Nimes, in Bohemia. (See *Siebold's Journ. für Geburtshulfe, &c.* vol. iii. part 1. Frankf. 1819.) In 1801, Dr. Schlegel, of Merseburg, likewise operated on a woman, who recovered, notwithstanding the bowels became strangulated, and she is still living, with a hernia in the situation of the wound. (*Schweighäuser, Archiv. des Accouchemens*, p. 135. 8vo. Paris, 1797.) The Cæsarean section has been performed by Graefe, and the woman and child were both saved. (*Journ.* b. 9.) Other instances of success took place in April, 1823, in the practice of Vanderfurh; (see *Revue Méd.*) and in Aug. 1823, in that of Schönberg, of Naples. (See *Salzb. Med. Chir. Zeitung.* for May, 27. 1824.)

From a statement made by Baudelocque, it appears, that the Cæsarean Operation had been performed twenty-four times with success between the year 1750, and the beginning of the present century; and, according to M. Velpeau, even without reckoning Lauverjet's cases, which are incontestable, it has also been practised with a favourable result, twice at Nantes, by Bacqua, on the same woman; once, at Aix, by M. Le Maistre; once, by M. Dariste, at Martinique; once, at Dahlen, by Vonderfuhr, in 1823; once in May, 1827, in the Hospital of Florence; twice by Schenck; once by Bulk; once by Graefe; once by Burns; and once more quite recently in the colonies. Let not practitioners, however, underrate the true danger of the operation; for, as M. Velpeau justly observes, no doubt every successful case has been brought before the public, while many unsuccessful ones have been kept out of view. His belief is, that at least half of the operations have had a fatal termination. (See *Nouv. Elem. de Méd. Opér.* t. iii. p. 677.)

Of operating when the Fœtus is extra-uterine.

Delivery cannot possibly happen in the ordinary way, when the fœtus is situated in the ovaries, or Fallopian tube, or in the cavity of the peritoneum.

However, there are many instances recorded of ventral pregnancies, which the mothers survived, the dead fœtus having been discharged by fragments out of an abscess in the parietes of the abdomen. A case, under Mr. Gunning, in St. George's Hospital, I had an opportunity of seeing a few years ago, in which the child was discharged piecemeal from an abscess of the abdomen; and I saw another case, under Dr. Blicke of Walthamstow, in which portions of bone and a great deal of matter had been voided through the vagina, though the swelling was altogether on the right side.

Practitioners are occasionally called upon to do a very similar operation to the Cæsarean, when the child has passed into the cavity of the peritoneum, in consequence of the rupture of the uterus. Unfortunately such an accident is not uncommon, and though the causes of it may not be obvious, nothing is more certain, than that the fœtus itself is entirely passive, and has no share in producing the misfortune. The symptoms, by which the event may be known, are not always clear. When, however, the pains have been violent; when the last, after being excessively severe, has been followed by a kind of calm; when the countenance loses its colour, the pulse grows weak, and the extremities become cold and covered with a cold sweat; when the abdomen is generally flat and only partially affected with the swelling occasioned by the fœtus, which either continues to move, or is dead and motionless; when the patient complains of a moderate degree of heat about the belly; and, lastly, when the child shrinks from the touch of the accoucheur; it is manifest that the uterus is lacerated. If the child has passed completely into the abdomen, its extraction by incision is the only resource; and whether this should be attempted or not, must depend upon circumstances. If a part of the child, however, were yet in the uterus, it might be extracted, with the aid of the forceps, if the head presented, or by the feet, provided only the upper part of the body were in the abdomen.

Baudelocque quotes three instances of gastrotomy, performed on account of rupture of the uterus. The first is that inserted by Thibaud Dubois, in the *Journal de Médecine*, for May, 1760. Every preparation was made for a natural labour, when, after excessively violent pains about the upper and left parts of the uterus, the child disappeared. Thibaud opened the abdomen, though not till some hours after the accident. The infant was dead; but the mother experienced no ill effects after the operation, except such as are usual after ordinary labours.

The second and third cases were communicated to the French Academy of Surgery in 1775, by Lambron. He practiced the operation twice, on the same woman, with success. In the first instance, he operated eighteen hours after the rupture of the uterus. The child was dead. An ill conditioned abscess formed near the wound; but the patient got quite well in the course of six weeks. She was pregnant again the following year, and the uterus was once more ruptured. Lambron now had recourse to the operation without delay. The child betrayed some signs of life, but soon died. The mother not only survived, but afterwards became pregnant again, and had a favourable delivery.

In a foregoing column, I have adverted to the case in which Dr. Locher, of Zurich, saved both the mother and child by the Cæsarean Operation, performed in the linea alba. After her recovery, a small point of the wound, not exceeding two or three lines in length and breadth, required a long time to be quite healed, though no particular inconvenience was experienced from it. Some time afterwards the cicatrix gave way again, and a portion of omentum protruded, which was reduced, when a piece of bowel came out, and was also returned. The edges of the wound were then brought together; but a small superficial ulcer continued open in spite of every effort to close it. In 1818, the year following that in which the Cæsarean Operation had been performed upon her, she became pregnant again, and the chief particularity, which happened during gestation, was an increase in the size of the preceding ulcer, which became three inches in width. The sore, however, was covered with charpie, and the integuments well supported with adhesive plaster. On the 23rd of May, she was seized with labour-pains; and, about seven in the evening, she complained all at once of a very acute pain, and at the same moment voided a considerable quantity of blood from the vagina. On examining by this passage, nothing was discovered; but when the hand was applied below the navel, in the line of the old wound, and under the ulcer, a circumscribed firm swelling was felt, caused by the child's head, of which the sutures were plainly discernible. Dr. Locher naturally concluded that the uterus had burst, so as to allow the child to escape, and the hemorrhage was thus easily explained. A repetition of the Cæsarean Operation was deemed indispensable. The place of the incision was determined by the round swelling, caused by the child's head. An incision six inches in length, was made into the abdomen, where a quantity of coagulated blood was found. When this had been removed, the membranes presented themselves, exhibiting a bluish hue, and, after they had been opened the head of the child immediately appeared. The navel-string passed round the neck, which was also compressed in the opening of the uterus. The child evinced no signs of life. The placenta came away during the attempts to reanimate the child. The uterus contracted, and there was little bleeding. This patient, after a good deal of indisposition, and occasional approaches to a perfect recovery, was at length attacked with inflammation of the stomach and bowels, and died on the 9th of July. The uterus was found contracted to a small size, with an opening, of about the size of an almond, on its anterior surface, with a rounded callous edge. This aperature Dr. Locher thinks had remained ever since the first operation, and had allowed the escape of the child in the second labour; a circumstance which may be doubted, as the hemorrhage indicated the period when the uterus had been lacerated, as this gentleman indeed has in one place particularly noticed himself. (See *Med. Chir. Trans.* vol. xi. p. 182, &c.) An almost incredible case is related of, what may be called, a Cæsarean birth, effected solely by the powers of nature, and, as would appear, by a sudden rupture of the uterus and parietes of the abdomen, after the patient had been in labour three days. (See *Essays and Obs. Physical and Literary*, vol. ii.)

A laceration in the uterus, or the wound made in this viscus in the Cæsarean Operation, may give rise to dangerous and even fatal symptoms of strangulation, if any of the intestines insinuate themselves into the preternatural opening. When such an occurrence happens in the performance of the preceding operation, the intestine must be directly withdrawn and replaced. If the accident were to happen when the child is extracted in the natural way, the bowel is to be pushed back into the abdomen from the uterus. Were the occurrence to take place several days after the operation, Sabatier inquires, what ought to be done? A surgeon is said to have pushed back the intestine from the uterus as late as the third day. Sabatier thinks, that later it could not be done. In this circumstance, Baudelocque advises the operation, suggested by Pigrai, namely, that of opening the abdomen and withdrawing the bowel from the place in which it is incarcerated. But the adhesions, which are soon formed, would be likely to frustrate the design.

Gastrotomy has not only been recommended for cases where the child has passed into the abdomen through a rupture of the uterus; it has likewise been advised for instances in which the fœtus has grown in the Fallopian tube, ovary, or cavity of the abdomen. Here, indeed, the operation deserves to be called Cæsarean; for, in addition to the incision in the skin and muscles of the abdomen, it is necessary to open the pouch, in which the child is contained. The instances of conceptions in the Fallopian tube are not uncommon. Those in the ovary, and cavity of the peritoneum, are more rare. Sabatier conjectures, that most of the cases reported to be of the latter kind, if attentively examined, would have been found to be in reality conceptions in the Fallopian tube.

Extra-uterine conceptions hardly ever arrive at maturity. However, the fœtus formed in the Fallopian tube has sometimes been known to attain the term of nine months, and then die, either from the impossibility of its expulsion, or from the insufficiency of the nourishment afforded it. The pouch in which it is contained, and the neighbouring parts, have then inflamed, and, after becoming connected together by numerous adhesions, have suppurated. The abscess has burst, partly at some point of the circumference of the belly, and partly into the rectum; and the dead fœtus has been discharged piecemeal with the matter.

In other examples, the fœtus, instead of giving rise to abscesses, has become ossified with the enveloping membranes, and continued in this state many years, without any other inconvenience to the patient, than what depended on the size and weight of the tumour within the abdomen.

Most frequently, however, the pouch containing the fœtus bursts, about the middle of the ordinary period of gestation, and the child passes into the cavity of the peritoneum. At the same moment, the blood-vessels, ramifying on the parietes of the containing parts, usually pour forth into the abdomen so much blood, that the patients generally die in the space of a few hours. (*See a case by Dr. Clarke in Trans. of a Society for the Improvement of Medical and Chirurgical Knowledge. Also another, adverted to by Sir C. Bell, in Med. Chir. Trans.* vol. iv. p. 340.)

Two facts of this kind fell under Sabatier's observation. The women were in the end of the fourth month of pregnancy. Excepting a swelling, which affected only one side of the abdomen, and frequent dragging pains in this cavity, there was no indication of any thing extraordinary. In other respects, the patients were well. They were both, all on a sudden, attacked with extremely acute pains, which lasted two or three hours. A more violent suffering than the rest was followed by entire ease. The abdomen subsided, and became flat. An equal, moderate warmth diffused itself over this part of the body. The skin lost its colour. Almost continual syncopes occurred. The pulse became feeble and concentrated. Cold perspirations ensued, and the women died. The rapid course of these symptoms rendered it impossible for Sabatier to be of any service. The patients were actually dying, when he was called to them. The examination of their bodies evinced, that the abdomen contained a large quantity of blood; that the fœtuses lay on the intestines, connected with the lacerated Fallopian tube by means of the umbilical cord; and that the tube itself, which was strongly contracted, presented no other tumour, except that which depended on the after-birth.

There is nothing that announces an extra-uterine pregnancy with sufficient certainty, to justify any positive conclusion respecting the nature of the case, before the ordinary time of parturition. In many women, the gravid uterus inclines to one side, and numerous pregnant females have dragging pains, which may depend upon other causes. Things, however, are different when the fœtus has lived to the ordinary period of parturition, and the woman is attacked with labour-pains; because, besides the unequivocal signs of the presence of a child in the abdomen, the womb is empty, and is little changed from its common state. Should we now, asks Sabatier, have recourse to the Cæsarean Operation, just as if the fœtus were in the womb? Can we be sure that the pouch which contains the child will contract like the uterus, and that the incision which is in contemplation will not give rise to a fatal hemorrhage? Would it be easy to separate and remove the whole of the placenta? How could the discharge, analogous to the lochia, find an outlet, and would not its extravasation in the abdomen be likely to prove fatal? Sabatier thinks, that the risk which is to be encountered is much less when things are left to nature. The child, indeed, must inevitably perish. It will either give rise to abscesses, with which it will be discharged in fragments, or it will remain for a length of time in the abdomen, without any urgent symptoms. Sabatier also calls our attention to the great precariousness of an infant's life, and expresses his opinion, that there can be no difficulty in deciding what conduct ought to be adopted. Happily, practitioners are not often placed in circumstances so delicate, and extra-uterine conceptions mostly perish, before the end of the common period of gestation. We have then only to second the efforts of nature; either by promoting suppuration, if it should seem likely to occur; by making a suitable opening, or enlarging one that may have formed spontaneously; by extracting such fragments of the fœtus as present themselves; by breaking the bones, when their large size confines them in the abscess, as Littre did in an instance where the abscess burst into the rectum; and, lastly, by employing suitable injections.

An extremely uncommon case of extra-uterine conception was related a few years ago by Josephi; the fœtus having at length passed into the bladder by ulceration, and caused such affliction, as rendered cystotomia indispensable, with the view of extracting the parts of the fœtus lodged in that organ. The operation was done above the pubes; but the internal mischief already existing was so great, that the patient did not recover. (*Ueber die Schwangerschaft ausserhalb der Gebärmutter;* Rostock, 1803, 8vo.)

Govei, p. 401, relates a case of ventral conception, in which instance the Cæsarean Operation was done, and the child preserved. A lady, aged twenty-one, had a tumour in the groin, which was at first supposed to be an epiplocele, but an arterial pulsation was perceptible in it. In about ten weeks the swelling had become as large as a pound of bread. Govei, solicited by the lady, opened the tumour. He first discovered a sort of membranous sac, whence issued a gallon of limpid fluid. The sac was dilated, and a male fœtus found, about half a foot long, and large in proportion. It was perfectly alive, and was baptized. After tying the umbilical cord, the placenta was found to be attached to the parts just behind, and near, the abdominal ring; but it was easily separated. Govei does not mention whether the mother survived. Bertrandi was unacquainted with any example of the Cæsarean Operation being done, in cases of extra-uterine fœtuses, so as to save both the mother and infant. This eminent man condemned operating, in ventral cases, on the ground that the placenta could not be separated from the viscera, to which it might adhere, or, if left behind, the subsequent inflammation and suppuration would be mortal. (See *Traité des Opér. de Chir.* chap. v.)

Ruth, a surgeon in Upper Silesia, performed the Cæsarean Operation successfully in a case of extra-uterine pregnancy, of some years standing, during which period the woman became pregnant in the usual way, and was safely delivered. (See *Graefe and Walther's Journ.* part 3. vol. vi.) The particulars, which are well deserving of the attention of obstetric practitioners, may also be found in one of our own periodicals. (See *Edinb. Med. and Surg. Journ.* vol. xxiii. p. 429.)

Whenever the Cæsarean Operation, or gastrotomy, has been performed, the practitioner is not merely to endeavour to prevent inflammation, heal the wound, and appease any untoward symptoms which may arise; he should also prevail upon the mother to suckle the child, in order that the lochia may not be too copious; and, after the wound has been healed, she should wear a bandage, for the purpose of hindering the formation of a ventral hernia.

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CALCULUS. Calculi form in the ducts of the salivary glands; in the kidneys, bladder, urethra, gall-bladder, &c. For a paper on calculi of the lachrymal sac, see *Graefe's Journ. für die Chir.* No. i. Berlin, 1820. For an account of stones in the bladder, refer to Urinary Calculi.

CALCULUS IN THE INTERIOR OF THE EYE. See Eye, &c.

CALLUS, *New-bone*, or the osseous substance which serves to unite the ends of a fracture. The process by which it is formed, and the differences between the *provisional* and the *definitive* calli, will be explained in the article Fracture.

CALOMEL. (Submuriate of mercury; hydrargyri submurias, L. P.) Its extensive utility, in surgical diseases, will be conspicuous in a large proportion of the articles in this work. When prescribed as an alterative, the common dose is a grain once or twice a day; when ordered as a purgative, from three to eight grains may be given; and when directed, with the view of exciting salivation, from two to four grains, conjoined with opium, are usually administered night and morning, and in urgent cases, like iritis, sometimes oftener, till a full impression is made on the salivary glands, and system at large.

CAMPHOR is used externally, chiefly as a means of exciting the action of the absorbents, and thus dispersing many kinds of swellings, extravasations, indurations, &c. Hence, it is a common ingredient in liniments. It has also the property of rousing the action of the nerves, and quickening the circulation in parts on which it is rubbed. For this reason, in paralytic affections, it is sometimes employed. Few applications have greater power in exciting the absorption of any tumour, or hardness, than camphorated mercurial ointment.

Camphor has also been recommended for the relief of stranguries, even those depending on the operation of cantharides. But although it may occasionally have succeeded, when given with this view, it not only does not always do so, but it has been known to cause an opposite effect, sometimes producing great scalding in voiding the urine, and pains like those of labour. (*Medical. Trans.* vol. i. p. 470.) In chordee, its utility is generally acknowledged. Persons who cannot procure rest, unless they take very large doses of opium, sometimes find smaller ones answer, if combined with camphor. (See *Brande's Manual of Pharmacy*, p. 46.)

CANCER. (Derived from the Latin *cancer*, a crab, to which a breast affected with this disease, and surrounded by varicose veins, was anciently fancied to have a resemblance.) Also *Carcinoma*, from the Greek χαρχίνος. Although the terms *cancer* and *carcinoma*, considered with reference to their etymology, seem decidedly to possess little recommendation, the moderns employ them with a far more precise and settled meaning than the ancients, unenlightened as they were by pathological anatomy. Still our knowledge of cancer is not even now sufficiently advanced to enable us to answer, conclusively, various questions respecting it. (See *Bégin* in *Dict. de Méd. et de Chir. Pratiques*, t. iv. p. 425.)

Formerly, a vast number of morbid alterations of structure, entirely different from one another, were confounded together under the name of cancer. The French ascribe to Laennec the merit of having first demonstrated the elementary texture of true cancer, and thus freed the subject from a great deal of confusion. I believe, however, that Home, Baillie, Hay, and Abernethy, had all promulgated their observations on cancer, when Laennec published. According to the latter distinguished pathologist, the human body is liable to two classes of accidental productions, or new formations: to the first belong certain abnormal textures, to which some of the natural tissues are more or less analogous: to the second appertain other abnormal textures, which have nothing analogous to them in any of the primitive tissues of the body. Amongst the productions of the latter kind, Laennec arranged *tubercles*, *scirrhus*, the *encephaloid*, *cerebriform*, or (as we more frequently call it) the *medullary tumour*, and *melanosis*. Notwithstanding all, or several of these abnormal elementary modifications of disease may exist in tumours, vaguely called cancerous, yet, as M. Bégin well observes, and M. Laennec admits it himself, it is particularly to *scirrhous* and *cerebriform*, or *medullary* formations, that the term cancer is applied. In this article, I shall exclude from consideration *tubercles*, which British pathologists never regard as cancerous, but generally as a form of scrofulous disease. Neither shall I enter, at present, into the subject of *melanosis*, which, though sometimes regarded as a species of cancer; as, for instance, by M. Alibert, who terms it *cancer mélané* (see *Nosologie Nat.* t. i. 1817, 4to.), will admit very advantageously of separate consideration. (See *Melanosis.*) According to Professor Carswell, carcinoma does not admit of a precise definition, but it may be said to consist in the formation or deposition of a peculiar substance which presents a great variety of consistence, form, and colour; frequently assumes a definite arrangement, and possesses a vascular organisation of its own; gives rise to the gradual destruction or transformation of the tissues in which it is situated; affects simultaneously or successively a greater or lesser number of organs; and has a remarkable re-productive tendency. Both *scirrhous* and *medullary* cancer, have long been looked upon as *malignant diseases*, though not with that discrimination and precision of meaning, which the valuable remarks of Mr. Travers are likely to establish. This gentleman considers carcinoma as a genus of the order "malignant diseases;" and agrees with Laennec, Carswell, and other eminent modern pathologists, in enumerating two species of it; the *scirrhous* and *medullary*. It is to incurableness from causes not local, and consequently the disposition to appear in more than one part at the same time, or to reappear when the first affected part has been freely removed, that Mr. Travers applies the term malignity. But if, from any local cause, a sore will not heal, or becomes gangrenous; if, by the extension of the ulcerative process, blood-vessels are opened, and fatal hemorrhage ensues; if, by the profuseness of a secretion, the patient dies exhausted; if, by the incessant irritation of the nervous system, or the morbid actions set up in vital organs under a protracted symptomatic fever, life is extinguished; the circumstances of the disease, viewed with reference to the above definition of malignity, would not imply that its nature was malignant. (See *Med. Chir. Trans.* vol. xv. p. 198.)

Dr. Carswell founds the essential character of heterologous formations, of which scirrhous and medullary cancer are examples, on the presence of a substance, which does not enter into the healthy composition of the body; and, under the generic term of *carcinoma*, he comprehends *scirrhous* (*scirrhoma*) and medullary cancer (*cephaloma*), with their varieties. His reasons for arranging these diseases together are the following:—1. They often present, in the early period of their formation, certain characters common to all of them, however much they may differ from each other in the subsequent periods. 2. They all terminate in the gradual destruction or transformation of the tissues which they affect. 3. They have all a tendency to affect several organs in the same individual. 4. They all possess, though in various degrees, the same reproductive character. (See *Carswell's Illustrations of the Elem. Forms of Diseases, Fasc.* 2.)

But though the varieties of *scirrhoma* and *cephaloma*, as they are named by Dr. Carswell, resemble one another in the foregoing respects, they present differences which this pathologist refers to two states of the heterologous deposit, to which they owe their origin. In *scirrhoma*, the deposit has little or no tendency to become organised. Its form and arrangement appear to be determined chiefly by external circumstances; and its production and increase are entirely dependent upon the nutritive function of the organ in which it is contained. In *cephaloma*, the deposit has a greater or lesser tendency to become organised; and, "although it may at first assume a determinate form and arrangement, in consequence of the influence of external circumstances, it possesses in itself properties, by means of which its subsequent arrangement and development are effected, independent of the nutritive function of the organ in which it is formed, except in so far as the materials of its growth may be derived from this source." (*Carswell, Op.* cit.)

With respect to the varieties of *scirrhoma,* when the heterologous deposit is collected in numerous points in the form of a hard, grey, semitransparent substance, intersected by a dull white or pale straw-coloured fibrous, or condensed cellular tissue, it is denominated *scirrhus.* When it assumes a regularly lobulated arrangement, so as to represent an appearance similar to a section of the pancreas, it forms what was called by Abernethy *pancreatic sarcoma,* but is better named by M. Bégin *pancreatic scirrhus,* the term sarcoma being strongly objected to by some pathologists, amongst whom I know is Sir Astley Cooper. Again, as Dr. Carswell observes, the heterologous deposit may be uniformly disseminated throughout the texture of an organ, which it converts into a solid substance, resembling raw or boiled pork, and named by the French *tissue lardace,* or *lardaceous tissue.* Lastly, when it presents the appearance of firm jelly, and is collected into masses of greater or less bulk in a multitude of cells, it is the *matière colloid* of Laennec, the cancer gélatiniforme, or, aréolaire of M. Cruveilhier. (See *Carswell's Illustrations of the Elém. Forms of Disease, Fasc.* 2.)

M. Laennec entertained the belief, which is not at present adopted, that every heterologous deposit, like those of scirrhus and cerebriform cancer, having nothing analogous to them amongst the primitive textures of the system, necessarily and invariably had two stages; one of *crudity,* the other of *softening.* The mistake on these points is, that the heterologous deposit does not always soften after a certain period, though it sometimes does so partially.

In the period of crudity, scirrhus is represented by Laennec as a substance sometimes perfectly white, but in other instances, bluish, or greyish, slightly transparent, and whose consistence is such, that dividing it with a scalpal usually causes a grating sound, the consistence varying, however, in different examples, from that of the skin of pork nearly to that of cartilage. The scirrhous substance is ordinarily homogeneous, but divided into masses, which are again subdivided into lobules, united by a dense cellular tissue, whose arrangement, though exceedingly diversified, appeared to Laennec to exhibit a kind of regularity, and to resemble that of the cells of a honeycomb. In some cases, the fibrous tissue, intersecting the scirrhous substance, presents a reticulated arrangement, in some, an arborescent distribution; and, in others, an appearance, as if it radiated from a central point in every direction around. Some scirrhi, when laid open, are fancied to look very much like the substance of a turnip.

When a section is made of a scirrhus in its first stage, we find, according to Mr. Travers's description, "a tough, inorganisable, and pretty compact mass, of a white and yellow brown colour, smooth, and moistened by a slightly unctuous fluid; its consistence is not uniform, being hard in the centre, so as to form a nucleus. The circumference is defined by the termination of red vessels, forming a vascular boundary." On maceration, "the texture opens, so as to bring into view concentric areolæ, having their interstices filled by a white granular matter, which may be picked out from the meshes. These areolæ are crossed by faint white lines, at irregular intervals, in the direction of radii from a centre, visible to the naked eye, and very conspicuous under a magnifier, giving the section some analogy to that of a lemon. In the second stage, when inflammatory action commences, and is announced by shoots of pain, the relative firmness of the centre and circumference of the tubercle becomes reversed, the centre being pulpy or broken, while the circumference retains its firmness. The surrounding parts are now found to have lost their natural elasticity by condensation of texture, and partake of the firmness and weight of the scirrhus, giving considerable apparent increase of volume to the tumour, which is now less defined at its margin, and, in fact, of a compound character." One particular opinion entertained by Mr. Travers is, that the dense opaque white lines, traversing the tumour in the direction of radii, and diminishing in density as they proceed outward, are not the production of the disease, but the septa, which divide and support the lobules of which the gland is composed, in an opaque and thickened state. (See *Med. Chir. Trans.* vol. xv. p. 208.) The correctness of this view seems rendered doubtful by the fact, that the radiating white lines are met with wherever the scirrhous formation is met with, whether in a gland or not; and sometimes shoot into the surrounding textures beyond the limits of the part originally attacked.

Notwithstanding the essential difference between schirrhoma and cephaloma seems to Dr. Carswell to consist in the former having little or no tendency, the latter a greater or lesser tendency, to become organised, it is sometimes impossible to draw a distinct line of separation between them; for, the heterologous deposit, when first formed, and, indeed, frequently for a considerable time after its formation, does not furnish any signs, which show that it will or will not become organised. 1. The heterologous substance may exist in the form of scirrhus, pancreatic sarcoma, or the lardaceous tissue, without presenting any trace of organisation; the textures which it invades being gradually destroyed by its presence, and both ultimately converted into a soft, granular, pulpy, or liquid mass, of the colour or consistence of cream or milk. 2. The heterologous deposit may exist under the same forms, but change into mammary, or medullary sarcoma, becoming more or less soft and vascular, and frequently terminating in hemorrhage by the rupture of its vessels, or in the state commonly, but improperly, termed fungus hæmatodes. According to Dr. Carswell, numerous examples might be given of scirrhus, medullary sarcoma, and fungus hæmatodes, originating in the same morbid state, and passing successively from the one into the other in the order here specified. Indeed, all the varieties, both of scirrhoma and cephaloma, are frequently met with, not only in different organs of the same individual, but even in a single organ. (See *Carswell's Illustrations of the Elem. Forms of Disease, Fasc.* 2.) A testis, which I lately removed in the North London Hospital, exhibited, in some places, fine specimens of mammary sarcoma; while, in others, its consistence was cerebriform, or medullary. Sir Astley Cooper once mentioned to me a case, in which he removed a diseased breast, the substance of which corresponded to scirrhus; a return of disease took place, and the tumour was then of the medullary kind. A true scirrhous texture of an unmixed form is rare in young persons. The examples, in which it presents itself, in combination with medually cancer, are principally noticed in individuals who have passed the middle period of life. Several of the varieties of both species of carcinoma appear to Dr. Carswell to differ materially from one another with regard to the comparative rapidity of their development, as well as their reproductive tendency; a fact of considerable practical importance. In both these respects, the pancreatic differs from the lardaceous, the lardaceous from the mammary; and the mammary from the medullary cancer. The first often remaining stationary for months or years; the last frequently acquiring its maximum of bulk in a few weeks, and when removed, being sometimes reproduced with a degree of rapidity which is never observed in any of the other varieties. Generally, the more the varieties of scirrhous and medullary cancer partake of the characters of cellular, cellulo-fibrous, and fibrous tissues, *cæteris paribus*, the less rapid are they in their growth, and the less is their tendency to be reproduced. (See *Carswell's Illustrations, &c. Fasc.* ii.)

If the disease be examined at the earliest period of its formation, while the heterologous substance has not effaced the particular texture of the part in which it is contained, the researches of Dr. Carswell prove, that the morbid substance becomes manifest to our senses, either as a production of nutrition or of secretion. "In the former case (says he) it is deposited in the same manner as the nutritive element of the blood enters into the molecular structure, and assumes the form and arrangement of the tissue or organ into which it is thus introduced. In the latter, it makes its appearance on a free surface, after the manner of natural secretions, as on serous surfaces in general."

Another interesting fact in relation to cancer is, that the heterologous substance is sometimes found within the vessels. According to M. Andral, solid fibrine in the blood-vessels sometimes constitutes in organs whitish masses, similar to cancerous tumours. In the body of a middle-aged man he found one of the lungs full of masses of this description. The middle ramifications of the pulmonary artery were gorged with solid matter, of a dirty white colour, reddish at some points, and at others liquid, and like greyish bouillie. On being attentively examined, it seemed to M. Andral to be nothing more than solid blood, reduced to elementary fibrine, with a little of the colouring matter at some points, and here and there in a state of fluidity. M. Andral traced a similar matter in the smallest vessels, as far as he was able to follow them, and he was convinced that the whitish masses, with which the lung was studded, instead of being a degeneration of the organ, or an accidental production in it, really consisted of small vessels filled with solid fibrine, more or less destitute of colouring matter. M. Andral likewise ascertained that cancerous masses are sometimes met with in the ramifications of the vena portæ. He noticed the same thing in the kidney: a fibrinous concretion, of a dirty white colour, was found occupying the renal vein, to the interior of which it was adherent; and it extended into the ramifications of the vessel, so that it could be traced into the smallest branches, and into parts of the kidney, where previously to the dissection, only white or pale red masses had been seen, which Laennec would have termed the encephaloid (medullary) matter in a state of crudity. M. Velpeau, who had observed similar facts, was led to infer that cancer may be primarily developed in the blood. But instead of adopting this conclusion, M. Bégin prefers the view entertained by M. Andral, in which a certain change of the fibrine of the blood is conceived to have an important share in the formation of some cancerous productions. (See *Dict. de Med. et de Chir. Pratique*, t. iv. p. 42.) As Professor Carswell remarks, the presence of the heterologous substance, which constitutes the several varieties of both species of carcinoma in the blood, is a circumstance of great importance; and unless it be clearly demonstrated to arise in consequence of a modification of the blood itself, we should find it impossible to explain many of the phenomena which it presents, more especially those which accompany its formation in the molecular structure of organs, and on the free surface of membranes. The following facts are regarded by Dr. Carswell as furnishing strong evidence, that the formation of this substance takes place in the blood, whether it be found in this fluid alone, or in other parts of the body at the same time: The presence of this substance, 1. in the vessels, which ramify in carcinomatous tumours, or in their immediate vicinity. — 2. In the vessels of a portion, or of the whole of an organ; to the former of which this substance is exclusively confined, and can be traced from the trunks into the branches and capillaries. — 3. In vessels having no direct communication with an organ affected with the same disease; as, for example, when it is confined to a small extent of the vena portæ; and lastly, in blood which has been effused into the cellular tissue, and on the surface of organs.

Dr. Carswell further observes, that the divisions of the vascular system, in which the carcinomatous substance has been observed, are the venous and capillary; and that in large veins, such as the vena portæ and its branches, the emulgent vein, &c., it may present the lardaceous, mammary, medullary, or hæmatoid characters, all in the same venous trunk.

The formation of these varieties of carcinoma in the blood is a curious and particularly interesting fact, more especially as bearing upon the long-disputed question, whether cancer is a local or a constitutional disease. Dr. Carswell believes that when the disease takes place in the intimate structure, or on the free surface of organs, its material element is separated from the blood, and deposited under a variety of circumstances which modify its form, bulk, colour, and consistence. He cannot, therefore, imitate some pathologists, who regard the seat of the two principal varieties of carcinoma, as limited to any one tissue, or who refer its origin to any modification of structure, or special organisation. And, with respect to the cystic origin of carcinoma, as suggested by Dr. Hodgkin (See *Med. Chir. Trans.* vol. xv. p. 292.); he remarks, that the presence of cysts in the liver, walls of the stomach, lungs, kidneys, brain, lymphatic glands, spleen and blood, is not to be detected at any period of the development of carcinoma, and, therefore, when they do occur in other organs, as the ovaries, testes, mammæ, &c., they must be regarded as a mere coincidence, or as a consequence of the disease, and not as a cause, or necessary condition of it. (See *Carswell's Illustrations of the Elem. Forms of Disease, Fasc.* 2.) The latter conclusion, I believe, has long been the prevailing one. We find it adopted by Home, Abernethy, and Travers. The latter remarks:—"Within the wall of the tubercle, one or more cysts, containing a dark yellow, or coffee-brown fluid, are sometimes met with, but are often not present." (See *Med. Chir. Trans.* vol. xv. p. 209.)

Cruveilhier regards all organic transformations and degenerations as exclusively the result of the deposition of morbid products in the cellular element of organs, and he believes that their *tissus propres* are incapable of undergoing any organic lesion, except hypertrophy and atrophy. But this view has been proved by Dr. Carswell to be incorrect, who shows that, in the liver and stomach, carcinoma can be distinctly seen to form in the molecular structure, or proper tissue.

The form assumed by the carcinomatous matter seems to Dr. Carswell to be determined, in a great measure, by external circumstances. The globular shape mostly occurs in organs possessing uniform density, and in parts submitted on all sides to equal pressure. On natural and accidental serous surfaces, although the deposit may be at first globular, it frequently becomes pyriform, either on account of the mode of its attachment, or of less resistance being made to its growth, in one direction than another. It assumes a fungiform shape when placed in circumstances facilitating its lateral, or retarding its anterior development, as when it meets with a dense unyielding substance during its progress, or having pierced the skin, is subjected to pressure. When accumulated in separate portions of the cellular tissue into rounded masses, grouped together, and included within a common capsule, it generally presents a lobulated appearance, and, in the submucous tissue in particular, it frequently exhibits the cauliflower or mulberry appearance. (See *Carswell's Illustrations*, &c.)

This eminent pathologist next notices the *stratiform* arrangement of carcinomatous matter, as principally met with in the subserous cellular tissue, and frequently in the form of thin circular patches, varying from the breadth of a pin's head to an inch or more. The *ramiform* arrangement and modifications of it seem to him to depend upon the carcinomatous matter being contained in the veins, lymphatics, or lacteals.

With respect to *bulk*, Dr. Carswell explains, that the quantity of carcinomatous matter deposited in the molecular structure or on the free surface of organs is extremely various, but perhaps never so great in the former as in the latter. In the liver, it may vary from the size of a pin's head to that of an orange. In more yielding organs, as the lungs, testes, and even the mammæ, it may equal in bulk the head of an infant, or of an adult, as exemplified in a cast preserved at University College, London; and, in the intermuscular and subcutaneous cellar tissue, its bulk is sometimes still more considerable.

Dr. Carswell very properly draws the attention of his reader to the influence of pressure in promoting or retarding the development of carcinomatous tumours. While their progress outwards is resisted by an unyielding fibrous membrane, they often remain for a considerable time nearly stationary; but, directly this obstacle is removed, they acquire a rapid increase of bulk, and as soon as the skin ulcerates, they often protrude in the shape of enormous fungi.

The carcinomatous swellings, which attain a very considerable size, are not those of a scirrhous, but of a medullary texture. In fact, as Dr. Carswell observes, the latter possess within themselves the power of increasing to an almost unlimited extent. It is to the vascular organisation of such tumours, that the rapidity of their growth, and their frequently great bulk, are to be attributed. A boy came to the North London Hospital with a medullary tumour about the size of an orange, situated over the lower costa of the scapula: in ten days, it occupied the whole of the axilla, reaching partly over its anterior margin, as well as very deeply into it.

I have already alluded to Laennec's doctrine, that the consistence of cancer varies, and that it is greater in the early than the late stage. The term *scirrhus*, implying induration, is commonly employed to express the early, or occult stage of cancer; while a softer condition of the part, or tumour, is frequently conceived to indicate a more advanced period of the disease. But, as Dr. Carswell remarks, the degree of consistence of carcinomatous formations is not an invariable character of a particular stage of their development; for, when first perceptible, they may be as hard as cartilage, soft as brain, or fluid as cream; or they may become soft or fluid, after having remained for a certain time in a state of hardness.

The variety in the consistence of carcinomatous formations is ascribed by Dr. Carswell to the following circumstances:—1. The nature of the organ in which the circinomatous deposit is contained —2. The elementary composition of the deposit.—3. The subsequent changes, occurring either in the deposit itself, or the tissues with which it is in contact.

According to the analysis of scirrhous and medulary deposits, published by Lobstein (*Traité de Anat. Pathol.*), seventy-two grains of scirrhous breast contained—

Albumen . .	2 grs.
Gelatine . .	20
Fibrine . .	20
Fluid fatty matter .	10
Water . .	20
	72

Seventy grains of scirrhous uterus contained—

Gelatine . .	15 grs.
Fibrine . .	10
Fatty matter .	10
Water . .	35
	70

In the early stage of medullary cancer, the tumour contained a greater quantity of gelatine than albumen; and in the more advanced stage, when the carcinomatous matter was of the consistence of soft brain, the albumen was much more abundant than the gelatine. This statement is worthy of attention, now that medullary tumours are frequently termed *albuminous*.

According to the important researches of Professor Carswell, when we examine anatomically a mass of carcinomatous matter contained in a large vein, or situated on the surface of a serous membrane, in loose cellular tissue, or on the surface of a sore or cicatrix, we find it composed of the following elements in various proportions, viz. carcinomatous matter, cellular, fibrous, and serous tissues, and blood-vessels. The *carcinomatous matter* almost always forms by far the greater bulk of the disease. If its consistence be considerable, it presents a uniform, granular, or radiated arrangement; if soft, a lobulated one. The *cellular tissue* is often in small quantity, and so fine as not to be perceptible till the carcinomatous matter has been separated from it by pressure, or maceration. The carcinomatous matter is inclosed in it, and separated by it into granules, lobules, &c. These it intersects in various directions, and it serves to conduct the vessels which administer to the nutrition and growth of the disease. The *fibrous tissue* is less frequently an element of carcinoma on the surfaces of organs; but the serous is often present, either rendering the carcinomatous matter encysted, or forming cysts in it of various sizes filled with gelatinous, albuminous, or other fluid. When carcinomatous matter is deposited in the molecular structure of organs, the quantity of cellular and fibrous tissues, intersecting it in various directions, is sometimes very considerable. (See *Carswell's Illustrations of the Elementary Forms of Disease*, p. 3.)

In true scirrhus the traces of vascularity are very faint; but, in medullary cancer, the adventitious membranes possess a high degree of vascularity. The vessels ramifying in them are not only numerous but large. By some they have been considered principally arterial; by others, venous. Dr. Hodgkin is not able to decide to which class of vessels they are most nearly allied. These newly formed vessels, though large and numerous, are extremely weak and tender, and derive little or no support from the structure by which they are surrounded. Hence, they are liable to give way at numerous points, whence proceed those frequent and extensive hemorrhages, which have led to the disease, being sometimes named fungus hæmatodes. (See *Hodgkin*, in *Med. Chir. Trans.* vol. xv. p. 334.) According to Dr. Carswell, the vessels of cephaloma, or medullary cancer, vary in diameter from the breadth of a hair to that of a line, and present that peculiarity of distribution, always more or less conspicuous in newly formed vessels, namely, the ramifications, of which they are composed, communicate with a common trunk at its opposite extremities, in the same manner as the hepatic and abdominal divisions of the vena portæ do with the trunk of this vessel. They are frequently varicous, and seem to Dr. Carswell to partake more of the venous than the arterial character. He describes them as formed apart from the vascular system of the surrounding tissues, and constituting the *proper circulation* of cephaloma. "The communication, which exists between these vessels and those of the organ in which the cephalomatous substance is contained, is frequently very imperfect; a circumstance which, together with the delicacy of their structure, renders them extremely liable to congestion and rupture. The most minute divisions of these vessels terminate by penicillated extremities in the carcinomatous matter, where they communicate with veins and arteries belonging to the affected organ. The latter vessels, which may be said to form the *collateral circulation* of cephaloma, are seldom so conspicuous as the former; but there are cases in which they appear to constitute the greater part of the vascular structure of the disease." The branches, seen in scirrhous, or scirrhoma, are only those of the vessels of neighbouring tissues, which have become enclosed within the heterologous substance. (See *Carswell's Illustrations of the Elementary Forms of Disease*, p. 3.)

Nerves have never been detected in any of the varieties of carcinoma as a *new formation;* but they are sometimes included within agglomerated tumours, or even in a single tumour that has happened to form in a situation through which they pass. (*Ib.*) Dr. Hodgkin is not aware that even a single nervous fibril has ever been discovered in the essential part of the adventitious growth. (See *Med. Chir. Trans.* vol. xv. p. 336.) But, though the substance of medullary cancer is not supplied with nerves, the nerves may become the seat of the disease. This has often been noticed in the optic nerves. (See *Wardrop on Fungus Hæmatodes.*) M. Jules Cloquet records an instance in which a cancerous tumour was situated in the great sciatic nerve, immediately below the quadratus muscle. At some points, it was very firm; at others, soft; while, in particular parts of it, there was an obscure feel of fluctuation. Its colour was a brownish red, and its surface streaked with turgid capillary vessels. Some of the posterior filaments of the sciatic nerve passed behind the tumour, and were separated from one another on a level with it, but without any perceptible change in their organization; all the others were lost in, and confounded with, the adventitious growth, which consisted of the scirrhous and cerebriform matters blended together, and presenting a marbled appearance. (See *Jules Cloquet, Pathologie Chir.* p. 187. 4to. Paris, 1831.)

Mr. Cæsar Hawkins concurs with the observations made by Sir Astley Cooper, M. Andral, and Professor Carswell, that cancer and encephaloid tumours are allied to one another, so that the two structures may be found together, or a tumour of one kind, removed from a part, may be followed in the same place by another of the opposite kind. "Even the local cancer of the scrotum may be succeeded by fungus hæmatodes; for a case of chimney sweeper's cancer has been published by Mr. Langstaff, which was operated upon, and the patient died of fungus hæmatodes of the os innominatum, lumber glands, and liver." (See *Lond. Med. Gaz.*, Aug. 1834, p. 681.) I have heard of several other cases confirming the truth of this observation; and one I saw myself, in a patient of the Bloomsbury Dispensary.

Mr. Hawkins justly observes, that some parts are more liable to one form of cancer than another. Thus scirrhus is common in the breast, but fungus hæmatodes (medullary cancer) rare; while the latter disease is frequent in the testicle, and the scirrhus variety of cancer rarely seen in it. Fungus hæmatodes of a muscle, or other soft texture, runs a different course from the same disease in a bone; and cancer is modified, according as it occurs in the breast, stomach, or uterus. In the skin, particularly, a considerable difference is observed in its appearance, progress, and degree of malignancy, from cancer of other parts; and even different parts of the skin are, in some respects, differently affected. (*Hawkins*, Op. et vol. cit. p. 683.)

External Characters of Scirrhus.

It was a remark made by Sir Everard Home, that when the disease originates by a small portion of the glandular structure of the breast becoming hard, it may be readily distinguished by the hard part never having been perfectly circumscribed, and giving more the feel of a knot in the gland itself, than of a substance distinct from it. The disease begins at a small spot, and extends from it in all directions, like rays from a centre. This is one feature distinguishing this disease from many others, which, at their first attack, involve a considerable portion, if not the whole, of the part in which they occur. Abernethy conceived, that though a true scirrhus might be checked, it could not be made to recede by the treatment which lessens other swellings. On this point, however, he was not positive; for other surgeons had informed him that diseases, which eventually proved to be cancerous, had been considerably lessened by local treatment. It is to be recollected, however, that some tumours, which end in cancer, are not from the first of this nature: consequently, in their earlier stages, they may yield in a certain degree to local applications, but completely resist them after the cancerous deposit has begun. Still we have the authority of Young, Recamier, Carswell, and others, for the fact, that the growth of cancer may be retarded by methodical pressure, and sometimes the disease even cured. Perhaps, therefore, to assert, that a scirrhus swelling is absolutely incapable of any diminution, would not be correct. We lately had a woman in the North London Hospital, whose breast I removed on account of a true scirrhus. The disease unfortunately returned, in the form of hard tubercles in the skin, as well as induration of the glands of the axilla, and above the clavicle. Now, in this instance, the hard masses in the skin were observed to be much smaller at some periods than others. A scirrhous tumour is sometimes surrounded by more or less inflammation of the adjacent textures; and, upon the subsidence of it, the swelling will of course appear lessened. Notwithstanding these circumstances, the backwardness of a scirrhous swelling to be dispersed or diminished may be set down, without risk of inaccuracy, as one of its most confirmed features.

Another character of scirrhus is to involve the contiguous textures in the same diseased action. The skin, the cellular tissue, the muscles, the periosteum, &c. all become implicated, sooner or later, if they are in the vicinity of scirrhous cancer. In this respect, Abernethy recognised one difference of it from medullary cancer, which is propagated along the absorbent system, while the parts immediately in contact with the enlarged glands do not generally assume the same diseased action.

As a scirrhous tumour increases, it generally, though not constantly, becomes unequal upon its surface, so that this inequality has been considered characteristic of the disease. The circumstances influencing the shape of the carcinomatous deposit, according to Professor Carswell's views, I have already explained: they prove, that the mere shape of the swelling is not a criterion of its nature.

Abernethy pointed out the error of dwelling too much on lancinating pain, as a test of a scirrhous tumour: first, because it does not prevail in every case, or in every stage of cases, in which it does occur; and, secondly, because it is a symptom attending other tumours which are unlike scirrhus in structure. (See *Abernethy's Surgical Works*, vol. ii. p. 69, &c.) M. Bégin agrees with Abernethy, that lancinating pain is by no means a characteristic sign of cancer; and it seems to him only to take place under circumstances, where the disease is situated in an organ, which is penetrated or surrounded by a greater or lesser number of nerves, derived from the medulla spinalis, and suffering irritation. This happens especially in cancer of the breast, face, limbs, and neck of the womb. As for cancer (medullary?) of the liver, kidneys, spleen, and lungs, it is alleged by M. Bégin scarcely ever to produce any lancinating pain, except when the disease has extended beyond the parenchymatous structure. (See *Dict. de Med. et de Chir. Pratiques*, t. iv. p. 434.) The fact of scirrhous tumours being often unaccompanied by such pain as is now so familiarly known, that I shall merely add the evidence of Mr. Travers, on this interesting point. "Not unfrequently (says he) the scirrhous tumour is perfectly inert, from the period of its formation to the close of life, undergoing very slight, if any, increase, and giving, when mental apprehension is appeased, no trouble to the subject of it. A lady, now under my observation, has been many years so situated, enjoying uninterrupted health, though considerably above 70 years of age. The tumour is of the size of a hen's egg, and has the genuine scirrhous character. She takes sarsaparilla as a beverage, and the probability is, that, what in no degree affects her health, will not eventually shorten her life." (See *Med. Chir. Trans.* vol. xv. p. 214.)

Scirrhous tumours are mostly developed slowly, without any perceptible increase in the temperature of the part, unless the textures, amongst which the cancerous deposit lies, happen to be the seat of inflammation. As for the heterologous substance itself, M. Bégin correctly regards it as a kind of foreign body which may mechanically irritate the organs and textures, in or amongst which it is placed, or more or less seriously impede their functions, so that when these are of first-rate importance in the economy, the result is inevitably fatal.

A scirrhous swelling rarely, or I may say never, acquires the magnitude, which the generality of other swellings are disposed to attain. According to Sir Astley Cooper, it usually increases from the size of a marble until it acquires two or three inches in diameter; "for it rarely happens, that the true scirrhous tubercle increases to a very considerable bulk; and this circumstance is one of its criteria." (*Lectures, &c.* vol. ii. p. 177.) Many scirrhi are even attended with a diminution or atrophy of the part. The pressure of the heterologous deposit on the surrounding textures fully explains their occasional removal and annihilation.

By some writers, unacquainted with the pathological anatomy of scirrhus, it has been asserted, that tumour is not an essential character of the disease. Now this observation is only correct in a certain sense. "It is true (says Sir Charles Bell) that there is not always an increase of the dimensions of the whole breast: on the contrary, true carcinoma is often accompanied with a contraction and diminution of the general bulk. But what is true of the breast or mamma, is not true of the tumour; for, the proper structure of the gland either shrinks or is compressed; and sometimes the surrounding fat is diminished by absorption, so that the whole mass is less than the natural breast, or than what the breast was before the commencement of the disease. But still the diseased part is properly a tumour; there we see an increased mass, a preternatural growth, or new matter, corresponding to the old definition, *morbosum augmentum*. But further, and in respect to the adipous membrane, the fat is not always diminished in carcinoma mammæ, but sometimes quite the contrary; and this difference in it will sometimes produce a variety in the external character, when there is none in the disease actually, or in the internal structure. Sometimes from the diminution of fat, the irregular tuberculated structure of this disease will be apparent to the eye, and to the touch; while, in another patient, the breast will be large, full, and smooth, only marked more than naturally with large blue veins, and having an ulcer like a hole dug in the centre of the breast." (See *Med. Chir. Trans.* vol. xii. p. 220.)

A truly scirrhous tumour of the breast, capable of changing into open cancerous ulceration, and of a certain size, is described by Sir Everard Home, as hard, heavy, and closely connected with the mammary gland, and, when moved, the whole gland moves along with it. When, indeed, all the following characters are present, no doubt can exist about the nature of the disease: an early puckering of the integuments; a dull brown, or leaden-coloured appearance of them; a knotted uneven feel of the swelling; occasional darting pains in it; an early fixed attachment of it to the skin above, and pectoral muscle underneath; and a retraction of the nipple. According to Sir Charles Bell, it is the ligamentous bands which produce the retraction of the nipple, by extending between its ducts, and destroying its spongy texture. (See *Med. Chir. Trans.* vol. xii. p. 233.)

Mr. Travers's description of the external characters of scirrhus is one of the best which I am acquainted with. "Hardness (says he), with increase of weight, inelasticity or toughness in some cases, knotty or craggy induration in others. Circumscription and mobility beneath the skin in its earliest stage, but not to such a degree in the subjacent bed as to allow of the fingers passing beneath the tumour and turning its edge upwards. Next, *i. e.* in the second stage, close adhesion to the tegument, and such incorporation with the glandular organ, in which it is seated, as to have no mobility but that of the gland itself upon the parts beneath. The adhesion of the skin either stretches, or partially retracts and puckers it, according to the smooth or unequal surface of the tumour, or to the close or loose attachment and particular conformation of the integument at the spot, as, for example, next the nipple, and at a distance from it; or beneath the mucous membrane of the pylorus, or rectum, and the common integument of the body. Third stage: contraction and diminution by pressure of volume in the gland as the tumour increases. Abrupt projection of one large coloured tubercle; sometimes of several smaller tubercles, or nodules. Irreducibleness of volume and hardness by topics or medicine. Transient pains, which have been hitherto obscure and occasional, now more distinct and frequent, like the pricking of a sharp instrument, with a sense of heat, or burning. Dusky or livid red colour of the skin, with resplendent tension. Excoriation or cracking of the skin at the summit or base of the tubercles, and fungous elevations, with ichorous and sanious oozing. Neither of these signs is individually diagnostic." (See *Med. Chir. Trans.* vol. xv. p. 205.) To continue the same gentleman's description, the ulcerative process at length opens the tumour, where the cracked and livid integument, previously exuding a sanious ichor, is most prominent, and the external opening is sometimes enlarged by a partial sloughing of the integument. Suppuration now takes place in the surrounding cellular membrane, and, as granulations spring up luxuriantly from the sides, the centre of the tumour gapes, and becomes a cavity more or less considerable. The granulations have a spongy or fungoid character, and are so elevated and broadly everted, as to give the appearance of additional depth and breadth to the sore. "As the sloughing process enlarges and deepens the centre, the disease becomes exceedingly offensive; and although granulations continue sprouting circumferentially at the same time, they have not the power of maintaining their vitality. It is in vain that we attempt to preserve the ulcer from foulness and fetor, by detergent applications; we can render it clean, but, in a day or two, the newly cleansed surface ulcerates afresh, instead of advancing towards cicatrisation." (*Travers*, in *Med. Chir. Trans.*, vol. xv. p. 211.) He adds, that in scirrhus it is not suppuration which, as in scrofulous and other tumours, brings the disease to the surface; nor does the skin ulcerate until after the scirrhus. "Encompassed by a dense wall, the centre breaks up by ulceration, constituting the state of occult cancer. Indeed, the scirrhus is seldom removed so early as to be found with its nucleus unbroken." (P. 213.) This observation agrees with that of Laennec, respecting the softening process, who only erred in representing it as invariably taking place.

Mr. Abernethy describes the diseased skin, covering a scirrhous tumour of the breast, as generally ulcerating before the swelling has attained any great magnitude: a large chasm is then produced in its substance, partly by a sloughing, and partly by an ulcerative process. Sometimes, when cells contained in the tumour are by this means laid open, their contents, which are pulpy matter of different degrees of consistence, and various colours, fall out, and an excoriating ichor ensues from their sides. This discharge takes place with a celerity which would almost lead to the belief, that it can hardly result from the process of secretion. Afterwards an attempt at reparation is made. New flesh is formed, constituting a fungus of peculiar hardness. This even occasionally cicatrises. But, though the actions of the disease are thus mitigated — though they may be, for some time, indolent and stationary — they never cease, nor does the part ever become healthy.

In the meanwhile, the disease extends through the medium of the absorbent vessels. Their glands become affected, at a considerable distance from the original tumour. The progress of carcinoma, in an absorbent gland, is the same as that which has been already described. The disease is communicated from one gland to another, so that after all the axillary glands are affected, those which lie under the collar-bone, at the lower part of the neck, and upper part of the chest, become disordered. Occasionally, a gland, or two, become diseased higher up in the neck, and apparently out of the course, which the absorbed fluids would take. As the disease continues, the absorbent glands, in the course of the internal mammary vessels, become affected. In the advanced stage, small tumours, similar in structure to the original disease, form at some distance, so as to make a kind of irregular circle round it.

The strongest constitutions now sink under the pain and irritation which the disease creates, aggravated by the obstruction, which it occasions to the function of absorption in those parts, to which the vessels leading to the diseased glands belong. Towards the conclusion of the disease, the patient is generally affected with difficulty of breathing, and a cough. (See *Abernethy's Surgical Works*, vol. ii. p. 72, &c.)

The general condition of the patient is excellently described by Sir Charles Bell: — After noticing the hectic fever which preys upon her, he observes, the countenance is pale and anxious, with a slight leaden hue; the features have become pinched, the lips and nostrils slightly livid; the pulse is frequent; the pains are severe. In the hard tumours, the pain is stinging, or sharp; in the exposed surface, it is burning and sore. Pains, like those of rheumatism, extend over the body, especially to the back and lower part of the spine, the hips and shoulders, &c. Successively the glands of the axilla, and those above the clavicle, become diseased. Severe pains shoot down the arm of the affected side: it swells in an alarming degree, and lies immoveable. At length, there is nausea and weakness of digestion. A tickling cough distresses her. Severe stitches strike through the side; the pulse becomes rapid and faltering; the surface cadaverous; the breathing anxious; and so she sinks." (*Med. Chir. Trans.* vol. xii. p. 223.)

One of the most deplorable effects, occasionally resulting from cancer, is so great a fragility of the bones, that those of the limbs are broken by the most trifling causes, as merely turning in bed, &c. Sir Astley Cooper mentions several examples of this fact. In the collection at St. Thomas's Hospital is the thigh-bone of a Mrs. Edge, which broke on her merely rising in bed; and also the thigh-bone of another cancerous patient, that was fractured by her turning in bed. (*Lectures, &c.* vol. ii. p. 184.) I have seen several instances of this fact myself. A female patient was in the North London hospital under Mr. Liston with a cancerous breast, and a humerus, which broke spontaneously. She had also had some other bone fractured in the same way; and, what deserves attention, the union had taken place very well. In the museum of University College is a thigh-bone, which gave way in a coachman as he was turning in bed, while he was labouring under cancer of the bladder. (See *Med. Chir. Trans.* vol. 17.) Other cases are recorded by surgical writers. (See *Fragilitas Ossium.*) It seems that the scirrhous substance is deposited in the structure of the bones, as the sternum of Mrs. Edge, above mentioned, fully illustrates; and in the museum at St. Thomas's are two curious specimens of diseased spine, in which much of the bone is absorbed, and scirrhous tubercles are deposited in the spaces produced by absorption. In University College Museum is a portion of the skull, containing a similar deposit, in lieu of osseous matter: it was taken from a woman, who died of a cancer of the breast.

In the above species of carcinoma described by Mr. Abernethy, the part is peculiarly hard, and rarely attains considerable magnitude. He admits, however, that there are varieties, and speaks of another case, in which the integuments sometimes remain pale and pliant; "and a surgeon who first sees the breast in this state, may doubt whether the disease be actual cancer or common sarcoma. The substance of the tumour is also much less hard than in the specimen first described; yet it is more compact and weighty than most other diseases of the same bulk, which are not carcinomatous. If the history of the disease accords with that of carcinoma; that is to say, if it began in a small district, and regularly and unabatingly attained its present magnitude; if the surface of the tumour be unequal, having produced in various parts roundish projecting knobs, the disease will almost invariably be found to be carcinoma. The skin will soon adhere to one or more of these prominences; it will ulcerate and expose the subjacent parts; and the future progress of the disease will accord to that of the harder and smaller specimen," except that the absorbents are much less liable to be affected.

The edges of a cancerous ulcer are hard, ragged, and unequal, very painful, and reversed in different ways, being sometimes turned upwards and backwards, and, on other occasions, inwards. The whole surface of the sore is commonly unequal: in some parts there are considerable risings, whilst, in others, there are deep excavations. The discharge, for the most part, is a thin, dark-coloured, fetid ichor; and is often possessed of such a degree of acrimony, as to excoriate, and even destroy, the neighbouring parts. In the more advanced stages of the disease, a good deal of blood is often lost from the ulcerated vessels. A burning heat is unversally felt over the ulcerated surface; and, this is the most tormenting symptom, that attends the disorder. Those shooting, lancinating pains, which are sometimes very distressing in the occult state of the complaint, become now a great deal more so. (*B. Bell.*)

According to Sir Charles Bell, scirrhus of the breast belongs to that period of life when the uterine functions cease. Menstruation becomes irregular, both in respect to time and quantity. Long intervals occur, after which the discharge is profuse, with unusual disturbance of the general system. The mamma, in particular, sympathises with the condition of the uterus; pains shoot through it, and it swells; and when the general fulness and tension subside, a partial hardness, an indurated lump, is left, with irregular margins, which mix with the substance of the breast. The hardness extends, until the whole gland is unusually firm, the disease becoming at the same time tuberculated, or knobby and irregular. The veins enlarge, and assume a deep blue colour. In the meantime, the strength declines, and the patient becomes emaciated. The nipple is now not only drawn in and incapable of erection, but retracted in comparison with the irregular convexity of the mamma. In a later stage, the skin is puckered and tucked in. These parts now firmly adhere to the subjacent mass, and sometimes there is bleeding from the nipple; in which case, the axillary glands are affected early.

The disease may begin very differently. A small hard tumour is felt deeply seated in the mamma. It is difficult to distinguish whether or not it is a part of the proper gland. It becomes painful, approaches the surface, becomes attached to the mamma and to the skin, and is gradually incorporated with them. The skin becomes discoloured, the surface moist, and the patient is apprehensive of the occurrence of a sore. At length the part does ulcerate, and begins to discharge. The bottom of the sore is foul and sloughy; the smell is offensive; and the constitution sympathises with the state of the sore. The whole gland is now hard, and adherent to the pectoral muscle. The edges of the sore are particularly hard, and present a dark red, glazed appearance. They are not everted, and curling; but rather depressed under the general convexity of the tumour. This will certainly be the appearance in a fat woman. The chasm is deep, with solid, abrupt, sharp edges. In proportion as its depth increases, the surrounding hardness extends, and the whole breast feels of a stony hardness.

Cancer of the breast sometimes assumes another form, which is also well described by Sir C. Bell: although the disease commences in the mamma, it rather propagates itself by extending its peculiar structure to the cutaneous glandular texture. Around the nipple, tubercles are felt in the skin, which extend to the skin of the breast, neck, and shoulders, and soon become painful. At first, they assume a high red colour; then, a yellowish transparency in the centre. They do not suppurate and break; but change into corroding ulceration.

It is a form of the same disease, says Sir C. Bell, when the breast presents a tumour elevated, tuberculated, and remarkably firm, without any elasticity, but, on the contrary, fixed to the side, and presenting one consolidated mass. The surface is granular, and of a deep, or rather dark red colour, with a bluish cast, somewhat like the colour of a peach. This tumour ulcerates, and sloughs, and bleeds profusely. The disease is propagated by tubercles under the skin, towards the sternum and clavicles; and it is a case soon accompanied with effusion in the chest. (*C. Bell*, in *Med. Chir. Trans.* vol. xii. p. 216. 220.)

On dissection, Sir Astley Cooper observes, that the breast is one solid mass like cartilage, with very little vascularity except at its edges, and internally fibrous. When the breast has acquired any magnitude, he says, there is generally an opening in it, in which case it has the appearance internally of being worm-eaten, and spongy. In the situation of the ulceration, it is very vascular, and bloody serum is met with. The absorbent glands put on the same character as the scirrhous breast. The cellular membrane, skin, and muscles are also affected. Sometimes the diseased glands above the clavicle press upon the thoracic duct, and thus interrupt the transmission of chyle into the blood. Hence the appetite is sometimes voracious, though the patient is rapidly wasting. In the chest, on the same side as the disease, hydrothorax prevails, and the absorbents on the pleura are in a morbid state, and small white spots, like pins' heads, are visible. Traces of scirrhous disorder Sir Astley Cooper likewise represents as occasionally existing in the liver, uterus, &c.

Causes of Cancer.

By some of the old writers the causes of cancer were referred to the presence of worms, which destroyed the parts, and produced all the local mischief. Strange as this doctrine may appear, one very analogous to it was adopted by the late Dr. Adams. (*Obs. on Morbid Poisons.*) When hydatids found their way into a solid substance, he supposed that the effect would be cancer; and he conjectured, that the success of an operation would depend, in a great measure, upon these animals being confined in a common cyst, for then they could be entirely removed; whereas, if they were unconnected, some of the smaller ones would be likely to remain. The absurdity of this doctrine, however, and the eccentric reasoning by which it is supported, make it quite unnecessary here to fatigue the reader with a particular explanation of it. Though hydatids are occasionally found in tumours, which have been called cancerous, they are not found often enough to make any part of the character of the disease; and they are met with in cases, in which there is not the least vestige of such disorder.

After cancer had continued some time, it was formerly believed that the matter was absorbed into the blood, and the whole system contaminated. Hence, was explained the fatal and rapid relapses after an apparent cure. To this view, my friend Mr. Travers decidedly inclines. However, the effects of absorption are supposed by others to be confined to the lymphatic glands, which intervene betwixt the sore and the heart; for, beyond these, it is said, that the absorbed matter is changed in its properties. (*J. Burns on Inflammation*, vol. ii.)

The disease is frequently imputed to blows, pressure, and other accidental injuries; but other circumstances are always concerned, which have more influence than the accidental violence. "Although (as Sir Astley Cooper remarks) the disease operates on some particular part of the body, it is always preceded by a state of constitution which has excited it. He who looks at this disease in the light merely of a local affection, takes but a narrow view of it. A blow, or a bruise, inflicted on a healthy person, would be followed by common inflammation only, which would lead to the removal of the matter effused. But, if a blow were received on the breast when the constitution was disposed to the formation of scirrhous tubercle, it would be the cause of a particular action being excited in the part injured, and might lay the foundation of this complaint. Yet the formation of scirrhous tubercle does not entirely depend on constitutional derangement; there must be also a peculiar action excited in the part." In order to prove that the disease must depend on constitutional derangement and an altered action in the part unitedly, Sir Astley observes, that, if a scirrhus be cut into, all the horrors of cancer will be the result of the injury; but if the cut be made in the healthy parts around the disease, no cancerous ulceration follows, and the wound heals. In short, he argues that the disease is the effect of a specific action in the part, preceded by a disposition in the constitution to its production.

In the breast, cancer frequently commences without any previous accidental injury of the part; a fact tending to establish the correctness of such writers as represent the disease to be of a constitutional nature. In these cases, there is always an irregularity, or disappearance of the menses; and the affection of the mamma may be supposed to depend on sympathy between it and the uterus. Certain it is, that cancer is very frequent about the time of life, when the menstrual discharge ceases.

It is a commonly received opinion, that cancer is an hereditary disease, or observed to prevail a good deal in particular families. Sir Astley Cooper has known it occur in three sisters. (*Lectures*, &c. vol. ii. p. 186.) Sir Everard Home has endeavoured to reconcile this to the doctrine of the disease being at first entirely of a local nature; circumstances which seem incompatible. "It is now universally admitted (says he) that children take after their parents in the general structure of their bodies, and therefore will be more or less liable to have the different solids of which they are composed disturbed by the same causes; and when a violence of any kind is committed upon them, it may be productive of the same diseases. In some families, the venereal disease shall always appear in the form of gonorrhœa [?]; in others again, rarely or never in that form, but, in that of chancre [?]. Strictures in the urethra are common in some families: they have taken place in a father, and all his sons, from very slight causes; such, indeed, as would not have produced the disease in others. Yet stricture cannot be called hereditary, because it is a local complaint arising from a local inflammation, differing in different people, according to the natural irritability of the parts which are affected. In this way, and this only, can cancer run in families, and be an hereditary disease," &c. (*Obs. on Cancer*, p. 150.) The observations, which this gentleman published respecting cancer, are valuable; but, I am doubtful about the correctness of one term, which is frequently met with in his work, and that of several other modern writers, viz. *cancerous poison*. At all events, I am not at present acquainted with any facts which satisfactorily demonstrate the existence of such virus. In support of the belief in the existence of a cancerous virus, it has been observed, however, "that we scarcely ever see glands diseased out of the course which the absorbed matter would naturally take, though they are affected in this manner in diseases, which can be propagated by irritation." (*Abernethy's Surg. Works*, vol. ii. *on Tumours*, p. 75.)

But, on the other hand, attempts have been made by Biett, Dupuytren, and Alibert, to propagate the disease by inoculation, but always without any result in proof of the existence of a virus. The fact of the substance of cancer being often found within the blood-vessels, the same heterologous matter as is deposited out of them, sufficiently proves to my mind, that the disease is constitutional, and depends upon a process, by which the adventitious substance is formed in, or from, the blood itself.

Cancer is most common in elderly persons; but, according to some writers, no age is exempt from the disease. Mr. J. Burns has seen it distinctly marked, and attended with a fatal event, in children of five years old: he mentions two instances of the eye being affected in such subjects; though, from the observations of Mr. Wardrop, we may now reasonably suspect, that these examples were really cases of fungus hæmatodes. An instance, in which a cancerous disease of the breast began at the age of fifteen, is related by Sir E. Home. (*Obs. on Cancer*, &c. p. 50.)

Sir Astley Cooper has frequently seen the disease at all ages between thirty and seventy. He does not recollect more than two cases, in which the nature of the tumour was decidedly scirrhous, in persons under thirty years of age. He has seen one case in a patient aged ninety-three; another in an individual of eighty-six; and he has removed an ulcerated scirrhus from a person seventy-three years old, who got well. According to Sir Astley's experience, the disease most frequently occurs about the age of fifty. The tumours met with in women under thirty, and often called scirrhi, he says, are only simple chronic enlargements, not disposed to malignant action, and not requiring removal. (*Lectures*, &c. vol. ii. p.185.)

Age makes a great difference in the whole class of carcinomatous tumours; and as Sir C. Bell has remarked, the same disease, distinguishable by obvious signs, will run its course rapidly, and with every symptom aggravated, in a woman of forty-five, while it will remain stationary for years in a woman of sixty or seventy. (*Med. Chir. Trans.* vol. xii. p. 216.) Sir Astley Cooper also states, that, when it occurs in very advanced age, it is slow in its progress, and does not in general shorten life. (*Lectures*, &c. p.185.)

According to Sir Astley Cooper, married women who bear no children, and single women, are more subject to this complaint than such as have large families. He thinks it very probable, that the natural change, which the breast undergoes in the secretion of milk, has some power in preventing this disease. But he admits, that the circumstance of a woman having borne children is not a perfect security against the complaint; and he knew one individual with this disease, who had been pregnant seventeen times.

His experience confirms a remark, made by other writers, that grief and mental anxiety seem frequently to have a great share in the production of scirrhus of the breast.

Treatment of Cancer.

Cancers have sometimes been supposed to be a general disorder of the system; sometimes merely local affections. This is a point of much importance in practice; for if cancers are originally only local affections, no objection can be made to extirpating them. They who think, that cancer is a constitutional disease, will have much less confidence in the operation, which they may even regard as useless, perhaps hurtful, inasmuch as it may convert a scirrhus into an open cancer, or bring on the affection in some other part.

Some practitioners, however, reject the doctrine of cancer depending on constitutional causes; and Sir E. Home's sentiments, in opposition to it, have been laid before the reader. When cancer breaks out again in the same part, after the performance of an operation, it is often owing to some portion of the disease having been blameably left behind, or to the operation having been put off too long. How likely it is, that some of the cancerous disease may be left unremoved by the operator, is obvious on considering the manner in which the white bands, resembling ligament, shoot into the surrounding fat; and that even the fibres of the muscles, beneath a cancerous disease, are frequently affected. At the same time, it must be allowed, that the disease is sometimes, to all appearances, so freely and completely removed, that its recurrence may be imputed, perhaps with equal probability, to the continued operation of the same unknown cause, which originally produced the first cancerous mischief. Sir Astley Cooper, and many other very experienced men, both of the past and present time, consider cancer as decidedly a complaint connected with a peculiar state of the constitution. But, if this be true, it may be asked, how can any cure be expected from the removal of the part, as the continued operation of the same constitutional causes must occasion a relapse? And so they sometimes do, no doubt, independently of the accident of any portion of the disease not being completely removed with the knife. However, experience proves, that the operation frequently effects a radical cure, and no other organ is afterwards attacked; which is analogous to what is seen after the amputation of a scrofulous limb; a case in which frequently no other part is afterwards attacked, though the constitution is unsound.

From the description, which Sir Astley Cooper has given of the dissection of persons destroyed by scirrhus, it must be inferred, not only that the disease is constitutional, but that the hope of radically curing it, either by medicines or an operation, must very often fail in advanced cases. He says, that a scirrhus in the breast is generally accompanied by several smaller tumors of the same character in different parts of the glandular structure. He notices the deposition of the scirrhous matter in the axillary glands, and those above the clavicle. On the left side, he says, the latter sometimes press upon the termination of the thoracic duct. According to his observations, the glands behind the cartilages of the ribs, when the disease is on the sternal side of the nipple, are generally diseased. The axillary glands on the other side of the body he has also seen in the same state. The lungs are often found inflamed, and adherent to the pleura; serum is effused in the chest; and the pleura costalis studded with scirrhous tubercles. He also describes the liver, uterus, ovaries, and bones, as participating in the morbid changes. (See *Lectures*, &c. p. 182. vol. ii.) In addition to all these facts, we are to remember the occasional presence of scirrhous matter in the blood-vessels themselves. Under such circumstances, the inutility of any treatment must be obvious.

Until late years, the accounts, given of the results of operations for cancers, were so unpromising, that they deterred many patients from undergoing a timely operation; which, for cancerous complaints, is the only remedy with which we are as yet acquainted, entitled to any confidence. As Mr. B. Bell remarks, the great authority of Dr. Alexander Monro must have had no inconsiderable influence even with practitioners, in making them much more backward in undertaking the extirpation of cancers than they otherwise would have been. "Of near sixty cancers," says he, "which I have been present at the extirpation of, only four patients remained free of the disease, at the end of two years: three of these lucky people had occult cancers in the breast, and the fourth had an ulcerated cancer on the lip." (*Edin. Med. Essays*, vol. v.) Dr. Monro also observes that in those, in whom he saw the disease relapse, it was always more violent, and made a quicker progress, than it commonly did in others on whom no operation had been performed. Hence he questions, "whether ought cancerous tumours to be extirpated, or ought the palliative method only to be followed?" and, upon the whole, he concludes against their extirpation, except in such as are of the occult kind, in young healthy people, and have been occasioned by bruises, or other external causes.

More modern experience, however, has afforded a very different result, and given rather more encouragement to the early performance of an operation, and even to making an attempt to cut away the disease, in every instance, both of the occult, and ulcerated kind, when such a measure can be so executed as not to leave a particle of the cancerous mischief behind.

Mr. Hill, in 1772, published some valuable remarks on the present subject. At this period, he had extirpated from different parts of the body eighty-eight genuine cancers, which were all ulcerated, except four; and all the patients, except two, recovered of the operation. Of the first forty-five cases, one only proved unsuccessful; in three more, the cancer broke out again in different parts; and, in a fifth, there were threatenings of some tumours, at a distance from the original disease. These tumours, however, did not appear till three years after the operation; and the woman was carried off by a fever before they had made any progress. All the rest of the forty-five continued well as long as they lived; or are so, says Mr. Hill, at this day. One of them survived the operation above thirty years; and fifteen were then alive, although the last of them was cured in March, 1761.

Of the next thirty-three, one lived only four months; and, in five more, the disease broke out afresh, after having been once healed. The reason why, out of forty-five cases, only four or five proved unsuccessful, and six, out of thirty-three, was as follows: "The extraordinary success I met with (says Mr. Hill), made cancerous patients resort to me from all corners of the country, several of whom, after delaying till there was little probability of a cure by extirpation, or any other means, forced me to perform the operation contrary both to my judgment and inclination."

Upon a survey, in April, 1764, made with a view to publication, the numbers stood thus: — Total cured, of different ages, from eighty downwards, sixty-three; of whom there were then living thirty-nine. In twenty-eight of that number, the operation had been performed more than two years before; and, in eleven, it had been done in the course of the last two years. So that, upon the whole, after thirty years' practice, thirty-nine, of sixty-three patients, were alive and sound; which gives Mr. Hill occasion to observe, that the different patients lived as long, after the extirpation of the cancers, as, according to the bills of mortality, they would have done, had they never had any cancers, or undergone any operation.

The remaining twenty-five, which complete the eighty-eight, were cured since the year 1764. Twenty-two of these had been cured at least two years; and some of them, it may be remarked, were seventy, and one ninety years old.

In the year 1770, the sum of the whole stood thus:—Of eighty-eight cancers, extirpated at least two years before: not cured, two; broke out afresh, nine; threatened with a relapse, one; in all, twelve, which is less than a seventh part of the whole number. At that time, there were about forty patients alive and sound, whose cancers had been extirpated above two years before.

Mr. B. Bell, who was present at many of these cases, bears witness to Mr. Hill's accuracy; and states, that "from these and many other authenticated facts, which, if necessary, might be adduced, of the success attending the extirpation of cancers, there is, it is presumed, great reasons for considering the disease in general as a local complaint, not originally connected with any disorder of the system." With respect to Mr. Bell's opinion, that a general cancerous taint seldom, or perhaps never, occurs, but in consequence of the cancerous virus being absorbed into the constitution from some local affection, much doubt attends even this supposition, though the practical inference from it is what cannot be found fault with, viz. in every case of real cancer, or rather in such scirrhosities, as, from their nature, are known generally to terminate in cancer, we should have recourse to extirpation as early as possible; "and if this were done soon after the appearance of such affections, or before the formation of matter takes place, their return would probably be a very rare occurrence." (*System of Surgery*, vol. vii.)

Sir Astley Cooper admits, that the operation is followed by a return of the disease in many cases, the averege number of which, however, he does not state, though he says that they do not amount to one fourth.

How often is the operation determined upon, because the nipple is retracted, and true cancer thereby announced! Yet, says Sir Charles Bell, with reference to the cause of this change, as previously explained, "it is quite clear, that if the nipple be fully retracted, and if this has been evident for any considerable time, the operation has been too long deferred." (*Med. Chir. Trans.* vol. xii. p. 223.)

Sir Astley Cooper is adverse to the performance of the operation when dyspnœa is present; for he has known patients die in two or three days, who had been operated upon while labouring under that symptom. On examination after death, water was found in their chests, and tubercles in the pleura.

The same experienced surgeon gives it as his opinion, that a breast should never be removed, unless the patient has undergone a course of alterative medicines, as compound calomel pills and the compound decoction of sarsaparilla, or (what he prefers) the infusion of gentian with soda and rhubarb. Thus he thinks the constitution may be improved, and the danger of a relapse diminished.

After comparing the different accounts of success given by Monro and Hill, well might Richter say: "*Jure sane dixeris, de uno eodemque morbo hos viros loqui, dubitari fere potest.*" (*Obs. Chir. fasc.* 3.)

Medicines and Plans which have been tried for the Cure of Scirrhus and Cancer.

It is a contested point, whether a truly cancerous disease is susceptible of any process by which a spontaneous cure can be effected. It appears certain, however, that a violent inflammation, ending in sloughing, may sometimes accomplish an entire separation of a cancerous affection, and that the sore left behind may then heal. Facts confirming this observation are occasionally exemplified where caustic is used, and accidental inflammations have led to the same fortunate result, as we may be convinced of by examples recorded by Sir Everard Home, Richerand, &c. The latter writer, adverting to the effort which nature sometimes makes to rid herself of the disease by the inflammation and bursting of the tumour, takes the opportunity to relate the following case:—A woman, aged forty-eight, of a strong constitution, was admitted into the hospital of St. Louis, with a cancerous tumour of the right breast. The swelling, after becoming softer, and affected with lancinating pains, was attacked with an inflammation, which extended to the skin of the part, and all the adjacent cellular membrane. The whole of the swelling mortified, and was detached. A large sore, of healthy appearance, remained after this loss of substance, and healed in two months. (*Nosographie. Chir.* t. i. p. 381. edit. 2.)

I once attended a woman who died of cancer of the uterus, and in the same room was her mother, all the forepart of whose chest was in a most mutilated state from the effects of sloughing, by which, at different periods, she had been freed from cancers of both her breasts. Baron Dupuytren believed that it was particularly when the cancerous mass was encysted, that the whole of it was capable of being destroyed by gangrene, and the patient completely cured. (See *Journ. Hebdomad. de Med.* t. iv. p. 38.) Many years ago, Mr. Cline had a patient in St. Thomas's Hospital, in whom the sloughing process went on to such an extent, under a linseed poultice, that the ulcer afterwards healed soundly. "I have seen (says Mr. Travers), more than one case, in which extensive cicatrices of ulcers existed, with much puckering and stretching of the skin of the chest, and no vestige of the breast remained. In one of these, the patient, a lady in Berkshire, resisted the pressing advice of a consultation of London surgeons to allow the extirpation of the tumour many years since. She has been in the constant habit of taking the medicine there prescribed, the extract of hemlock, almost *ad libitum*. She is still a stout healthy looking person, as formerly, and attributes her cure to the medicine. (See *Med. Chir. Trans.* vol. xv. p. 213.)

In general, however, inflammation renders things worse instead of better, and by converting occult cancers into ulcerated ones, hastens the patient's death, or at all events renders the cure more difficult, and forbids any attempts, which, on such a principle, might be made for his relief.

Of the general remedies, narcotics, as conium, opium, belladonna, &c. have been employed with most hope.

Cicuta, or conium maculatum, owed its reputation to the experimenting talent of Storck, who has written several treatises on it. According to him, cicuta possesses very evident powers over cancer, and has cured a great many cases; but, in less prejudiced hands, it has not been found successful; and even in many of the instances, adduced by Baron Storck of its utility, it is by no means proved that the disease was really cancer. The public have now little or no reliance on this medicine, as a means of relieving cancer. Mr. J. Burns declares, that, in cancerous ulceration, he never knew hemlock produce even temporary melioration. (See Conium.)

Belladonna was highly recommended by Lambergen. During its use, he kept the bowels open with clysters, administered every second day. The dose should be, at first, a grain of the dried leaves, made into a pill. The quantity may be gradually increased to that of ten or twelve grains. The extract is now frequently exhibited, the dose being at first one grain, and afterwards increased by degrees to five. The reputation of belladonna has not been supported by any decided success in cases of true cancer.

Hyosciamus has often been tried, and was held in great estimation by the ancients. Mr. J. Burns employed it occasionally, but with little effect. The common dose, at first, is three grains of the extract.

Aconitum has also been given; and, as it is a powerful and dangerous narcotic, a patient usually begins with only half of a grain of the extract night and morning. Solanum dulcamara, Paris quadrifolia, phytolacca, &c. have also been recommended; but they are now hardly ever employed, which is a sufficient proof of their inefficacy. Mr. J. Burns tried the hydro-sulphuret of ammonia; and Richter prescribed the laurus cerasus, without success.

Digitalis lessens vascular action, and may act on schirri, like abstinence, bleeding, &c. It has, however, no specific virtue in curing cancerous diseases.

Opium is seldom employed with the intention of curing cancer, although probably it has just as much power of this kind as other narcotics which have been more frequently used. For the purpose of lessening the pain of cancerous diseases, it is very freely prescribed.

Tonics sometimes improve the general health; but they never produce any specific effect on the local disease.

Justamond thought arsenic a specific for cancers. Further experience has not, however, confirmed the truth of this opinion, though there are practitioners, who continue to think highly of the efficacy of this mineral in certain forms of disease which have sometimes been classed with cancer. It cures numerous ill-looking sores on the face, lips, and tongue, and is one of the best remedies for lupus. Arsenical powder and paste, employed with considerable success by Dupuytren, as external applications, in the treatment of inveterate ulcers of the lips, nose, and other parts, are noticed in the article Arsenic. The powder I have tried in some cases, in the North London Hospital, and found its effects correspond to Dupuytren's account. Mr. Hill even thinks, that arsenic will, "in a great majority of cases, retard the progress of the true scirrhous tumour, and often prevent its becoming cancer. In some, it has appeared to dissipate such swellings completely." (See *Edin. Med. and Surgical Journ.* vol. vi. p. 58.)

Mercury, in conjunction with decoctions of guaiacum, sarsaparilla, &c. has been recommended, but, as Mr. J. Burns remarks, no fact is more certainly ascertained, than that mercury always exasperates the disease, especially when in the ulcerated state.

Muriate of barytes at present retains no character as a remedy for cancer.

Carbonate of iron was particularly recommended by Mr. Carmichael. Besides the carbonate of iron, he sometimes prescribed the tartrate of iron and potass, and the phosphate, oxyphosphate, and suboxyphosphate of the metal. Some constitutions can bear these preparations only in small quantities; they affect most patients with constipation, and many with headach and dyspnœa. Mr. Carmichael has seldom given less than thirty grains, in divided doses, in a day, or exceeded sixty. He prefers the suboxyphosphate for internal use, and states, that it answers best in small doses, frequently repeated. It should be blended with white of egg, have a little pure fixed alkali added, and then be made into pills with powdered liquorice. Aloes is recommended for the removal of costiveness. When half a grain is combined with a pill, containing four grains of carbonate of iron, and taken thrice a day, the constipation will be obviated. When the internal use of iron brings on headach, difficult respiration, a quick, sometimes full pulse, which is also generally hard and wiry, excessive languor, lassitude, &c. the iron is to be left off, and four grains of camphor given every fifth hour.

At the same time, that preparations of iron were internally administered, Mr. Carmichael employed externally, for ulcerated cancers, the carbonate, phosphate, oxyphosphate, and arseniate of iron, blended with water, to the consistence of a thin paste, which was applied once every twenty-four hours. To occult cancers, the same gentleman applied a solution of the sulphate of iron, ℥j. to lbj. of water. The acetate of iron, diluted with eight or ten times its weight of water, was also used. These lotions were put on the part affected by means of folded linen, wet in them, and covered with a piece of oiled silk to prevent injury of the clothes. (See *An Essay on the Effects of the Carbonate and other Preparations of Iron upon Cancer, &c.* 2d ed. 8vo. Dublin, 1808.)

Many remedies have acquired celebrity in cases of cancer, because very bad and malignant diseases, only supposed to be cancers, have got well, under their use. Such is probably the case with the carbonate of iron.

The only mode of treatment which Mr. Pearson ever saw do any particular benefit to cancer, was that of keeping the patient on a diet, barely sufficient for the support of life, such as barley-water alone, tea, &c. A milk diet has also been recommended.

With respect to the effects of a very low diet, Sir Astley Cooper protests strongly against the plan: if the patient be already weak, he says, you will thus render her still weaker, and soon bring her to the grave: in proportion as the strength declines, the pulse is quickened. He further declares, that we possess no medicine, which has any specific power over the disease, though the state of the constitution may sometimes be improved by Plummer's pills given at bedtime, and the following draught in the day: ℞ Infus. Gentian. ℥iss. tinct. columbæ ʒj. Ammon. carbon. gr. v. Sodæ Carbon. ʒss. Misce. Climate he also regards as having no particular effect on schirrous disease. Sir Astley Cooper only sanctions the use of steel medicines, when the uterine secretion is defective. In such cases, he recommends the compound calomel pill at night, and the following draught twice a day: ℞ Vini ferri ʒj. Ammon Carbon.

gr. vij. Aq. Menth. Vir. ℥j. Tinct. Cardam. c. ℥ss. He also approves of anodynes for the relief of the suffering; as the tinct. opii, the liquor opii sedativus, or the black drop, combined with the camphor mixture, and a little of the spir. ætheris comp. One of his patients derived much relief from the following pill: ℞. Ext. Stramonii gr. ½ Camph. gr. ij. M. ft. Pil. Bis. terve in die sumend. (See *Lectures*, &c. vol. ii. p. 193.)

The old surgeons dressed cancerous sores with narcotic applications. Vesalius used cloths dipped in the juice of the solanum; whilst others employed it mixed with oil of roses, and preparations of lead and antimony. Others had recourse to hyosciamus, or hemlock poultices, which in many cases, as Mr. J. Burns observes, have abated pain, and diminished fetor; but this is all which can reasonably be expected. He thinks carrot poultices better than those of hemlock, as they produce as much ease, and more powerfully diminish the fetor.

Sir Astley Cooper has no confidence in the utility of evaporating lotions. Warm applications he also represents as improper. The dressing, which he mostly prefers for scirrhi, is a plaster, made by blending ℥j. of the extract of belladonna with ℥j. of soap cerate. When inflammation is present, he does not object to the use of leeches. All local applications, as well as internal medicines, he considers merely as palliatives.

The fetor of cancers having been thought to resemble that of the sulphuret of potash (liver of sulphur), and the oxygenated muriatic acid being the best agent for decomposing and destroying such smell, it has been recommended as an application to cancerous sores. It may correct the fetor, but it will never accomplish a cure. Carbonic acid has been said not only to correct the fetor, but, in some instances, completely to cure the disease. It was long ago proposed, says Mr. J. Burns, by Peyrilhe, and was again brought forward by Dr. Ewart. Experience, however, has not shown that the efficacy of carbonic acid, in cases of cancer, is very great. Fourcroy remarks: "After the first applications, the cancerous sore appears to assume a more favourable aspect; the sanies, which flows from it, becomes whiter, thicker, and purer, and the flesh has a redder and fresher colour; but these flattering appearances are deceitful, nor do they continue long, for the sore speedily returns to its former state, and its progress goes on as before the application." The method of applying carbonic acid was by means of a bladder, the mouth of which fastened round the sore with adhesive plaster. The air was introduced by a pipe, inserted at the other end. Sometimes the fermenting poultice is employed. That iodine commonly fails, is now universally admitted, and this even in very large doses. (See *Paper by Dr. Buchanan of Glasgow, in Lond. Med. Gaz. of Oct.* 1836.)

Tar ointment, gastric juice, absorbent powders, &c. have been tried; but, without any evident good. (See *J. Burns on Inflammation*, vol. ii.)

Mr. Fearon rejected all internal remedies, as inefficient in the treatment of cancer, and, in the early stages of the complaint, recommended a method of practice, founded on his idea of the inflammatory nature of the disease. "In the beginning of scirrhous affections of the breast and testis, the mode I have adopted of taking away blood, is by leeches repeatedly applied to the parts. In this course, however, I have often been interrupted by the topical inflammation produced by these animals around the parts where they fastened. In delicate female habits, I have often lost a week, before I could proceed to the re-application of them. When the symptoms lead me to suspect the stomach, uterus, or any of the viscera, to be so affected, that the complaint either is, or most probably, soon will become cancerous, I then have recourse to general bleedings. But whether topical or general, perseverance for a sufficient length of time is necessary. Though the pulse never indicated such practice, yet the patients have not suffered by repeated bleedings; on the contrary, when they passed a certain time without losing blood, they felt a return of their symptoms, and, of their own accord, desired to be bled again. To this plan of repeated bleedings, I joined a milk and vegetable diet, avoiding wine, spirits, and fermented liquors." Mr. Fearon used also to keep the belly open, and employ saturnine applications.

Methodical compression was first recommended and practised in this country, as a means of curing cancer, by Young; and the same practice was afterwards put to the test of experience in the Middlesex Hospital; from which institution the report of Sir Charles Bell tends to prove, that compression, applied either to scirrhous or to ulcerated cancer, is decidedly hurtful. MM. Breschet and Ferrus also came to the same conclusion. (See *Dict. de Méd.* 1822.) The principal advocate for it, at present, is M. Recamier, who attributes the failures of it in the Middlesex Hospital to its not having been applied in a suitable manner, nor modified according to the stages of the disease. M. Recamier combines likewise the administration of hemlock with a very low diet, without which, he observes, that the latter medicine produces scarcely any effect. (See *Récherches sur le Traitément du Cancer par la Compression, Simple ou Combinée*, 8vo. 2 tomes, Paris, 1829.) I lately tried Recamier's plan in a case of scirrhus in the North London Hospital; but it seemed only to accelerate the conversion of the disease into open cancer.

From the preceding accounts we may infer, that no reliance is to be placed on any known remedy, or plan, in cases of real schirri and ulcerated cancers. The operation is the only rational chance of getting rid of the disease; and to waste time, so as to allow the disorder to increase in a serious degree, merely for the sake of trying various unpromising medicines, is conduct unworthy of a wise surgeon's imitation.

Perhaps, in the early stage, it may be right to make trial of arsenic, conium, preparations of iron, or those of iodine, and of friction, with the ointment of the hydriodate of potass. In this country the ointment employed varies in strength from ℈j. to ʒiss of the hydriodate to each ounce of lard. Graefe is alleged to have succeeded in bringing about an absorption of the whole of the diseased breast, by applying an ointment composed of ʒj. of hydriodate of potass, and ℥ij. of lard. Mr. Hill, of Chester, has recorded one case very favourable to trials of iodine. The cancer was in the ulcerated state. He dressed it with an ointment consisting of ʒj. of the hydriodate to ℥j. of lard; and gave the patient internally thirty drops at a time of a solution of thirty-six grains of the hydriodate in an ounce of distilled water. The result was such amendment of the disease, that a cure was confidently expected; but, in the end, the ulcer resumed its former dimensions and malignant character. (See *Edin. Med. Journ.* No. 87. p. 283.)

Upon the whole, the operation is the most likely means of getting rid of cancerous diseases. It is always admissible when every particle of the disease can be removed by it; when the absorbent glands are unaffected; and the constitution is not too far deranged. Even open cancers, if they can be entirely cut away, may yet admit of it.

The removal of cancerous disorders, even in the slightest and most trivial cases, should always be effected with the scalpel, in preference to caustic; the use of which, though it may sometimes succeed by producing a complete destruction of the diseased parts, causes severe agony, and, in the event of its not acting sufficiently on all the diseased parts, often renders the complaint more aggravated, and kills the patient in a very short space of time.

In cases of cancer, the irritation, generally occasioned by every application of the caustic kind, together with the pain and inflammation which commonly ensue, are strong objections to the practice. Plunkett's remedy, which is chiefly arsenic, is equally objectionable. Nor can we at once so certainly extirpate every atom of cancerous mischief with any caustic, as we can with the knife; for, with this, we immediately gain an ocular inspection of the surface surrounding the disease, so as to see and feel whether the disordered parts are completely removed, or whether any portion of the disorder requires a further employment of the instrument. With respect to the pain, that of caustics is infinitely greater, more intolerable, and more tedious, than that occasioned by the knife. When caustic also fails in destroying every particle of the disease at once, it almost always tends to enlarge, in a very rapid way, the original boundaries of the mischief. For an account of the method of removing schirri and ulcerated cancers, see Mamma, Removal of.

An escharotic, which has been of late strongly recommended for cancerous affections, is the chloride of zinc, employed in the form of paste. On this subject my friend Mr. Crosse, of Norwich, observes, "It can of course only avail when the disease is still local; but the cases related by Drs. Canquoin, Ure, and Rioffrey, many of which occurred under the eye of most able surgeons, prove that this escharotic destroys the scirrhous tumour, speedily, leaving an ulcerated surface, which often readily heals; and, moreover, it induces no danger from absorption, which is a recommendation not possessed by the arsenical paste." The cuticle being first removed by a blister, the phagedenic paste is applied, composed of one part of chloride of zinc, and two of sulphate of lime. (See *Ure*, in *Lond. Med. Gaz.* vol. xviii. p. 287.; *Canquoin*, *Mém. sur un Nouveau Mode de Traitément des Affections Cancéreuses*, Paris, 1835; and *Riofrey*, *New Treatment of Malignant Diseases and Cancer*, Lond. 1836.) This writer states, that the paste not only destroys the tumour, but purifies the surrounding atmosphere. He uses the chloride of zinc mixed with different proportions of flour, and has applied it to a tumour on the inside of the mouth, and also to the os uteri, with a good result. (See also *J. G. Crosse*, in *Prov. Med. Trans.* vol. v. p. 25.)

Dr. Ure, in some observations on lupus, recently published, communicates the following particulars respecting the chloride of zinc: — "The preparation of the chloride, which I proposed and introduced into practice in this country, differs in a most important feature from that originally employed by M. Canquoin. The wheaten flour, prescribed in the French formula, is apt to envelope the chloride in a glutinous dough, which blunts its power, or, at any rate, tends to confine its action to the particles on the surface of the paste; but the anhydrous gypsum of my formula, while it can exercise no chemical action upon the chloride, forms a porous medium, through which the whole of the particles of the delitescent chloride may transude upon the morbid albuminous tissue, with the effect of decomposing, or destroying it, with certainty, to any definite depth. This preparation of mine has been adopted in several of the London Hospitals, and has been found to be unfailing in its escharotic powers." (See *Lond. Med. Gaz.* Dec. 3. 1836.) The action of the chloride, and also of the nitrate of zinc upon albumen, and their consequences, in relation to the albumen of cancer, are discoveries to which this gentleman lays claim. (See Zinc.)

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CANCER SCROTI. CHIMNEY-SWEEPERS' CANCER. (See Scrotum.)

CAN'CRUM ORIS. A deep, foul, irregular, fetid ulcer, with jagged edges, on the inside of the lips and cheeks, attended with a copious flow of offensive saliva. It is a perfect specimen of phagedenic ulceration, and in its worst forms not unlike hospital gangrene, as I have seen several deplorable instances of. It also resembles the ulceration and sloughing in the mouth, produced by mercury. The gangrenous inflammation of the pudenda of children is of a similar character. (See *Kinderwood*, in *Med. Chir. Trans.* vol. vii.)

The disease is rarely seen in adults; but most commonly in children from the age of eighteen months to that of six or seven years. The gums, as well as the lips and cheeks, are sometimes affected, in which circumstance the teeth are generally carious and loose. The ulceration is occasionally attended with abscesses, which burst either through the cheek, lip, or just below the jaw. Exfoliations are not unfrequent, and, when the disease is neglected, extensive sloughing sometimes happens.

According to Dr. Cuming, in most instances, the ulceration, commencing in the gums, extends to the lips and cheek, but sometimes it begins in the mucous membrane of the lips or cheek, and thence extends to the gums. This disease is set down by Dr. Cuming as most frequently making its attack during the period of the first dentition, though often met with in children between three and seven years of age.

"When the disease occurs in infants on the breast, it is generally attended with a purplish and spongy appearance of the gums and roof of the mouth; and the ulceration, which lays bare the necks of the teeth, both externally and internally, is of a greenish, or ash-colour, and very much disposed to bleed. The salivary discharge is increased; the tongue is white; the mouth feels hot; the bowels are for the most part confined; and the child in general labours under a greater or less degree of fever." (See *Dublin Hospital Reports*, vol. iv. p. 331.) Dr. Cuming has not seen this form of the disease, previously to the irruption of the four superior incisors, but he has frequently seen it when the child had only six or eight teeth; and he has constantly observed, that, when it occurs thus early, it is the upper gum that is first and principally attacked. This appears, to Dr. Cuming, the mildest and most manageable form of the disease; and he describes it as rarely attended with sloughing.

The second variety, noticed by Dr. Cuming, occurs in children between the ages of twenty months and seven years. The ulceration generally begins in the gums, whence it extends to the lips or cheek. Sometimes it is of an acute, sometimes of a chronic nature, and attended accordingly with more or less sloughing. In the very worst forms, however, though the sloughing is considerable, the ulceration is always predominant. (Op. et vol. cit. p. 341.)

The third variety described by Dr. Cuming is, at first, confined principally to the cheek or lips. It begins with ulceration of their membrane, which is soon followed by that hard, red, shining, and circumscribed swelling, which, if the disease be not arrested, will speedily pass into gangrene. In this variety, gangrene predominates over ulceration; and the constitutional disturbance resulting from it may prove fatal.

Living in a marshy situation, want of wholesome food, and inattention to cleanliness, are conducive to this disorder, which is often met with in houses where children are crowded together. One of the worst cases, however, which I have ever seen, was in a child of an opulent family in Essex. The complaint is sometimes suspected to be contagious.

The first, or mildest form, is well known generally to admit of being cured by purgatives, aided by some of the applications presently specified.

In the second form, Dr. Cuming, after clearing out the bowels with a brisk cathartic, confides chiefly in an alternative of mild mercurials with aperients. The local applications preferred by him, are the black wash, and a dilute solution of muriatic acid in honey. When the ulcerated surface is in contact with carious, or loose teeth, these should be removed. Dr. Cuming tried the liquor arsenicalis and cold salt water bath, without advantage.

In the third variety, where gangrene is predominant, the disease mostly proves fatal. Dr. Cuming has employed various local applications, such as the mineral acids, dilute and pure, the oxymel æruginis, the butter of antimony, solution of the nitrate of silver, the black wash, &c., but mostly without any good effect. I have likewise tried all these applications in vain, as well as solutions of the chloride of soda of different strength. With such external means, cinchona, sulphate of quinine, carbonate of ammonia, opium and wine, have been prescribed; yet, for the most part, unavailingly. (See *Cuming*, in *Dub. Hosp. Reports*, vol. iv. p. 343. 345.)

The treatment recommended by Dease, consisted in administering muriatic acid internally, using it as an application to the disease; giving the patient a nourishing diet, with jelly, wine, &c., and occasionally prescribing an emetic.

In the worst form of the disease, I have found the concentrated nitric acid one of the most useful applications, especially when assisted with the internal exhibition of sulphate of quinine and dilute sulphuric acid.

Mr. Pearson extracted diseased teeth and loose pieces of bone; directed a milk and vegetable diet, with a prudent quantity of fermented liquors; and prescribed bark, sarsaparilla, and elm bark with sulphuric acid. The best applications seemed to him to be diluted mineral acids; burnt alum; the decoctum cinchonæ, with sulphate of zinc; tincture of myrrh; lime-water, with spirit of wine, &c. (See *Pearson's Principles of Surgery*, ed. 2. p. 287.)

CANTHA'RIDES. Spanish, or French flies, with which the common blistering plaster is made. In surgery, the tincture of cantharides is sometimes prescribed in incontinence of urine, gleets, &c. It is occasionally added to stimulating liniments, to increase their effect. Cantharides, applied to the skin, or taken into the stomach, have a peculiar tendency to act upon the urinary organs, and especially to irritate and inflame the neck of the bladder, and occasion strangury. In children, these effects are particularly frequent. In 1810, Robiquet announced the discovery of a new principle, to which the active properties of the blistering beetles are referrible, and to which Professor Thomson, of Glasgow, gave the name of cantharidin. (See Blisters.)

CAPELINA (from *capeline*, a woman's hat. French). A double-headed roller, the middle of which is applied to the occiput. After two or three circles, the rollers intersect each other upon the forehead and occiput; then one being reflected over the vertex to the forehead, the other is continued in a circular track. They next cross each other upon the forehead, after which the first head is carried back obliquely towards the occiput, and reflected by the side of the other. The last is continued in a circular direction; but the first is brought again over the sagittal suture, backward and forward, and so continued, till the whole head is covered. By the ancients, this bandage was sometimes applied in cases of hydrocephalus: it has no advantage, however, and is now hardly ever used.

CAPILLARY FISSURE. A very minute crack in the skull. The term came into use from its presenting the appearance of a hair.

CAPISTRUM. (See Bandage.)

CARBUNCLE (from *carbo*, a burning coal), is divided into the *benign* and *malignant* kinds, or into what are termed by French pathologists *anthrax* and *charbon*, examples of which last are afforded, in what is sometimes termed the *malignant pustule*, and in the carbuncle of plague, called therefore *pestilential*. Fortunately, all cases met with in England correspond to the anthrax of Dupuytren; for no opportunities of remarking the *pestilential carbuncle* have occurred in England since the deplorable periods of 1665 and 1666.

Besides the diffuse forms of gangrene and sphacelus of the subcutaneous cellular tissue, there is likewise "a circumscribed form, which is observed in furunculus, carbuncle, or anthrax. The great accumulation of blood, and the still greater and rapid effusion of serosity, which takes place in these circumscribed acute inflammatory affections, produce a state of extreme induration of the cellular tissue, a greater or lesser portion of which, being thus as if strangulated, dies from want of nutrition, becomes separated from the living parts, and is expelled in the form of a grey or straw-coloured spongy or pulpy mass, through an opening made in the skin by a similar process, by ulceration, or a surgical operation." (See *Carswell's Illustrations of the Elementary Forms of Disease*, p. 7.)

Anthrax, or common carbuncle, resembles a boil (see Furunculus), in being attended with gangrene of the subcutaneous cellular tissue, and, if one high authority can be credited, of certain processes of that texture within the skin. (*Dupuytren, Clin. Chir.* vol. iv. p. 109.) It is remarkable for constituting a circumscribed dark red, or livid swelling, accompanied by burning heat, stiffness, and for soreness in the part; and, occurring most frequently in parts of the body, where the skin is thickest, and abounds most in those processes of cellular tissue which are described by Dupuytren as extending between its areolæ. Thus, the nape of the neck, the back, the spaces over the scapulæ, the sides of the chest, and the nates, are the ordinary situations of anthrax.

Anthrax differs from a boil, not only in being of more considerable size, but in being usually single, and bursting by several small apertures; whereas several boils frequently form together, or occur in succession, and when one of these tumours bursts, it does so by a single opening in its apex. The skin, which covers the anthrax, and especially what lies over its centre, is of a deeper and more livid red colour, than what is seen over a boil. The mortified cellular tissue is deeper and more extensive in anthrax, than a boil, in which it forms only a central nucleus, or *core*. The surface of the tumour is flatter than that of a boil, which always rises in a conical shape above the level of the skin, while its base does not penetrate so deeply as that of a carbuncle, which is a great deal broader than the more superficial part of the tumour. It is the nature of anthrax to produce gangrene and disorganisation of the subcutaneous cellular tissue, and sometimes a destruction of even the subjacent muscles, and deeper textures, the mass of dead parts constituting frequently a slough of a lightish colour, portions of which, mixing with the discharge, sometimes communicate to it an appearance, compared by Sir Astley Cooper to that of flour and water. Sometimes, however, the matter is bloody and sanious. Boils chiefly occur in children, and young plethoric persons; the anthrax is mostly seen in subjects beyond the middle period of life, whose constitutions have been seriously impaired by intemperance, or other causes.

The occurrence of anthrax on the limbs is uncommon. Mr. Hunter, however, had seen the disease so situated: I have met with examples of it on the occiput, side of the neck, in various parts of the back, and on the nates.

Anthrax, or common carbuncle, is essentially different from the malignant pustule, so frequent in some of the southern parts of Europe (see *Larrey, Mem. de Chir. Militaire*, t. i. p. 104, &c.), in not being contagious. It differs also from pestilential and malignant carbuncle (the *charbon*, of French pathologists), in the same important respect. (See *Dupuytren, Clin. Chir.* t. iv. p. 111.) This latter also regards the malignant pustule and pestilential carbuncle as essentially gangrenous diseases, whereas simple anthrax seems to him to be so merely from strangulation of the processes of cellular tissue extending into the structure of the true skin. The correctness of this statement seems to be rather doubtful; because there can be no carbuncular disease, whether benign or malignant, without a gangrenous disorganisation of the cellular tissue, and the influence of constitutional causes. This is certain; but, whether constriction of the inflamed tissues, as alleged by Dupuytren, be the principal cause of gangrene, is a point which is far less clear. We find, indeed, that it is the character of carbuncular inflammations, first to produce sloughing of the cellular tissue, even where this may not be covered by any dense unyielding parts, though occasionally it afterwards destroys all textures down to the vertebræ, or scapulæ, themselves. The gangrene, I should say, is independent of the constriction and confinement of the textures affected. The first symptoms are great heat and violent pain in some part of the body, on which arise one or several vesications, attended with great itching and a burning heat; below which a circumscribed, but very deep-seated and extremely hard tumour may be felt.

Anthrax, or common carbuncle, sometimes appears in persons affected with typhoid symptoms, in which case it is attended with great weight and stiffness of the adjacent parts; the patient is restless and pale, the tongue white, or of a deep red, and moist; the pulse low, urine sometimes pale, sometimes very turbid, with all the other symptoms, in an exaggerated degree, which attend typhoid fevers. The patient often complains much of his head, either from pain or giddiness. Sometimes, he is drowsy; at other times, he cannot get the least sleep. Occasionally, he is delirious. The case is also apt to be attended with chilliness or rigors, and profuse perspirations. The patient is sometimes costive, sometimes afflicted with a profusion of stools; he generally complains of loss of appetite, nausea, and vomiting; takes but little nourishment; complains of difficulty of breathing, and is extremely low, with palpitations of the heart, and sometimes faintings. (See *Bromfield's Obs.* vol. i. p. 122.)

The progress of carbuncles to the gangrenous state is generally quick. Their size is various: they have been known to be as large as a plate. Considerable local pain and induration always attend the disease. The skin, indeed, has a peculiar feel, like that of brawn. As the complaint advances, several little vesicles arise, and under these apertures generally form in the tumour, through which a greenish, bloody, fetid, irritating matter is discharged. The internal sloughing is often extensive, even when no sign of mortification can be outwardly discovered.

The degree of peril may generally be estimated by the magnitude and situation of the tumour, the age of the patient, and the state of his constitution. Carbuncles on the head are often fatal.

With regard to the local treatment, the principal thing is to make an early and free incision into the tumour, so as to allow the sloughs and matter to escape. If the carbuncle be large, a crucial incision is mostly preferred, because the compact mass of disorganised cellular tissue will be long in getting completely out, unless the opening be made very free. The extremities of each cut should go two or three lines beyond the boundaries of the disease. (See *Dupuytren, Clin. Chir.* t. iv. p. 112.)

As much of the contents as possible should at once be pressed out, and the part covered with a poultice. Until the tumour is opened, no applications are more proper than an emollient poultice; but after an incision has been made, the poultice should be made rather stimulating; like that composed of oatmeal and port wine, the common fermenting poultice, or a linseed one, with which a proportion of Peruvian balsam is blended. Fomentations also afford considerable relief, both before and after an opening has been made. As the discharge is exceedingly fetid, a fresh poultice is necessary two or three times a day. Poultices are to be continued, till all the sloughs have separated, and the cavity becomes clean, after which the ulcer may be dressed with red precipitate ointment. Peruvian balsam, or a solution of nitrate of silver, 10 grs. to the ounce of water. Dupuytren, after opening the tumour sometimes continued the poultice, and, in other instances, employed gently stimulating dressings. When the carbuncle is situated on the posterior part of the trunk, the patient should not lie on his back; for then the skin would slough, notwithstanding the incision. (See *Dupuytren, Clin. Chir.* t. iv. p. 113.)

The manner in which the disease is protracted, by not making a proper opening in due time, cannot be too strongly impressed upon the mind of every practitioner, and it may justly be regarded as a frequent reason of the fatal terminations of numerous cases. Mr. Bromfield long ago forcibly inculcated the necessity of making a timely opening for the discharge of the sloughs; for, says he, "in case you rely on the opening made by nature, the thin matter only will be discharged, the sloughy membranes will remain, and the orifice close up." (See vol. i. p. 128.)

It was formerly not an uncommon custom to remove the most prominent portions of carbuncles with the knife, or to destroy them with the actual and potential cauteries. Many foreign surgeons are partial to the hot iron, the employment of which was sanctioned by Pouteau. (See his *Œuvres Posthumes.*) Even now they sometimes touch the apex of the swelling with muriate of antimony, or the actual cautery, especially when the pain is excessively severe; and the practice is alleged to be the most expeditious mode of relief. However, Dupuytren makes a distinction between anthrax and malignant carbuncles, observing that the proper cure for the former is an incision, but for the latter, the actual or potential cautery. In America, emollient poultices are continued until vesications appear, openings form, and a bloody serum begins to be discharged: the surface of the tumour is then freely covered with caustic vegetable alkali, which of course produces a good deal of pain, but this soon subsides, and the severe burning agony, peculiar to the complaint is now quite removed. It was Dr. Physick who first explained the proper period for the application; without which knowledge, Professor Gibson says, much mischief has resulted from ill-timed incisions, and the actual and potential cauteries. (*Institutes of Surgery*, vol. i. p. 52.)

With respect to the constitutional treatment, the continental surgeons, in the beginning of the case, before a slough has formed, usually prescribe gentle diaphoretic drinks, containing a sufficient quantity of tartrate of antimony to open the bowels. After this stage, they have immediate recourse to tonics and cordials. It should always be remembered, that the disease is for the most part met with in bad constitutions, and in persons who are weak and irritable. Hence, bleeding is rarely allowable. Bark, sulphate of quinine, camphor, wine, opium, æther, and the regulation of the bowels, with calomel and other means, are the internal medicines most commonly needed. The diluted sulphuric acid is highly proper, as well as aromatics and a nourishing diet. As the pain is severe, opium is essential. The constitutional treatment is analogous to that of mortification. (See MORTIFICATION.)

I once attended an elderly man who had a carbuncle, as broad as a dinner-plate, over the scapulæ: he died of phlebitis, with abscesses in various organs, and in two or three of the large joints.

Ant. Tosi, De Anthrace seu Carbunculo Tractatus. 4to. Venetiis, 1576. This tract, notwithstanding its antiquity, contains useful precepts. *Bromfield*'s Chir. Cases and Obs. vol. i. *Hunter* on the Blood, Inflammation, &c. *Richter*'s Anfansgr. der Wundarzn. b. i. *Boyer*, Traité des Maladies Chir. t. ii. p. 50, &c. *Physick*'s Case of Carbuncle, with Remarks on the Use of Caustic in that Disease, in the Philadelphia Journ. of the Med. and Physical Sciences, vol. ii. p. 172. *W. Gibson*'s Institutes and Practice of Surgery, vol, i. p. 50, &c. Philadelphia, 1824. *Dupuytren*, Clinique Chir. t. iv. p. 109, 8vo. Paris, 1834. *Rob. Carswell*'s Illustrations of the Elementary Forms of Disease; *Fasc.* on Mortification.

CARCINOMA (from καρκίνος, a crab). See Cancer.

CARIES (from κείρω, to abrade). Caries is a disease of the bones, supposed to be very analogous to ulceration of the soft parts; and this comparison is one of great antiquity, having been made by Galen. However, by the generality of the ancients, caries was not discriminated from necrosis.

It was from the surgeons of the eighteenth century, that more correct opinions were derived respecting caries. Until that period, writers had done little more than mention the complaint and the methods of treating it. Some new light was thrown upon the subject by J. L. Petit, in his remarks upon exostosis and caries. (*Mal. des Os*, t. ii. chap. xvi. p. 27.) But as he only spoke of the disorder as one of the terminations of exostosis, he has not entered far into the consideration of it. The best observations on caries were first made by Dr. A. Monro, *primus*. (*Edin. Med. Essays*, vol. v. art. 25.) This memoir contains the earliest correct ideas of *dry caries*, or *necrosis*, which is rightly compared to mortification of the soft parts, and named *gangrenous caries*.

The bones, like other parts of the body, are composed of arteries, veins, absorbent vessels, nerves, and a cellular texture; they are endued with vitality; they are nourished, they grow, waste, are repaired, and undergo various mutations according to the age of the individual; and they are subject to diseases analogous to those of the soft parts. To the phosphate of lime, which is more or less abundantly distributed in their texture, they owe all their solidity; and, perhaps, it is to the same inorganic substance that the difference in their vital properties and in their diseases, from those of the rest of the body, is to be referred. In fact, this particular organisation and inferior vitality of the bones, are generally supposed to account for the small number, peculiar character, and generally slow progress of their diseases. (*Dict. des Sciences Méd*. t. iv. p. 80.)

Bones of a spongy texture are more frequently attacked by caries than such as are compact. Hence, the vertebræ; astragalus, and other bones of the tarsus; those of the carpus; the sternum; the bones of the pelvis, and the heads of the long bones, are often affected; and the bones of young persons are unquestionably more frequently the seat of caries than those of old subjects.

But though the soft and spongy bones are most subject to caries, they sometimes suffer a degree of injury sufficient to produce the death of a portion of their texture. Thus in a case, where a musket-ball had struck the head of the tibia, a sequestrum was found in it, with a cloaca leading down to it. (*Liston*, in *Edin. Med. and Surg. Journ*. No. lxxviii. p. 50.) In the fine plates of Weidmann, and the cases recorded by him, the same fact, as the effect of disease, was long ago illustrated.

According to the observations of Mr. Syme, when caries occurs in the tables of the skull, or the cylindrical bones, it is uniformly preceded by a morbid expansion of the compact structure into a state resembling that which naturally belongs to those, where the disease usually resides. He notices that the shafts of bones, and especially that of the tibia, are frequently enlarged and thickened, in consequence of chronic inflammation, and at the same time loosened in their texture, so as to present nearly the same appearance as that of the spongy articulating extremities. "In bones so altered, caries occasionally occurs, or, I should rather say, a condition resembling caries, since it differs from this disease in one important feature, viz *incorrigibleness*. I have hardly ever known this pseudo-caries resist the local application of blisters, and internal use of oxymuriate of mercury; and I have felt very uncomfortable in seeing extensive incisions, rasping, trephining, actual cauteries, &c. employed ineffectually to cure complaints admitting of such easy remedy." (See *Edin. Med. and Surg. Journ.* vol. xxxi. p. 257.)

In necrosis, the bone is entirely deprived of life: in caries, the vital principle exists; but a morbid action is going on, whereby the texture of the bone is altered, and rendered softer and lighter than natural. But, though these disorders are essentially different from each other, they frequently occur together in the same part, as Weidmann, Liston, and others have correctly explained. In syphilis, this fact is often exemplified, the degree of necrosis predominating over that of caries.

In the most common species of caries, a loose, fungous flesh grows out of the interstices, formed on the surface of the diseased bone, and bleeds from the slightest causes; while, in the soft parts, a sinus generally leads down to the caries, and emits a fetid, dark-coloured sanies. These symptoms, however, as well as the tendency in the accompanying ulcer or sinus to produce large fungous granulations, are more constant in cases of necrosis than in those of caries, some of which may remain a considerable time unattended with any outward sore, abscess, or sinus, as is illustrated in caries produced by various diseases of the joints. And, indeed, particular forms of caries (if they deserve that name) are rarely accompanied with suppuration; a fact to which I shall again advert.

"The absorption of bone, like that of soft parts (says Dr. Thomson), may be distinguished into interstitial, progressive, and ulcerative. We have ample proofs of the interstitial absorption, or that which is daily, hourly, and unceasingly taking place from every part of the substance of bone, in the deposition and removal of phosphate of lime, that has been tinged with madder. If too much earth be removed, the quantity of animal matter will be relatively increased, and a disposition given to softness of the bones — a state, which exists in the bones of children in the disease called the rickets, and in the bones of older people, in that denominated mollities ossium, or the rickets of grown people.

"I have already had occasion to mention the effects of the progressive absorption of bone, as manifested in the progress of aneurisms and other tumours of the skin; but the formation of pus is by no means a necessary, constant, or even frequent attendant on the progressive absorption in bone. Hydatids in the brains of sheep, tumours growing from the pia or dura mater in the human body (see Dura Mater), or aneurism seated over the cranium, or within the cavity of the chest, are often the cause of the whole substance of a bone being removed, layer after layer, by progressive absorption, without the formation of a single particle of pus. (See Aneurism.) This state of the bone has often been confounded, but improperly, with that state of the bone which arises from ulcerative absorption, the state which is properly denominated caries, and in which one or more solutions of continuity may be produced upon the surface, or in the substance of the bones. The ulcerations, occasioned in bones by the venereal disease, afford by far the best marked examples of the effects and appearances of ulcerative absorption, or caries in bones," &c. (See *Thomson's Lectures on Inflammation*, p. 389.)

The prominent feature both of ulceration and caries, is loss of substance through absorption. But, as Mr. Mayo properly observes, " caries is something more than mere absorption. When an aneurism of the aorta presses against the sternum, or the vertebræ, the bones are gradually eaten through; they are partially absorbed; but they are not carious. When, however, the face is attacked with lupus, and the ulcer, spreading in depth and breadth, reaches the bones, and they become excavated simultaneously with the soft parts in the enlarging ulcer, the osseous tissue is not only absorbed, but truly carious. In caries, absorption is preceded by a change in the bone, which (with very few and doubtful exceptions) has a well marked inflammatory character. The same condition exists during the progress of the absorption. There is further present an imperfect restorative action, which is shown in the more or less partial growth of unwholesome granulations from the ulcerated surface. Of these changes, the inflamed condition of the bone is the primary and most important; the absorption is secondary and accidental. Absorption may be prevented by subduing the inflammation; or may, after having begun, be arrested, and the crop of unwholesome granulations converted into a healthy restorative growth, if the case is of such a nature as to allow of the suppression of the inflammatory or specific action." (See *Outlines of Human Pathology*, p. 36.)

Caries has been divided into several kinds, according to the nature of its causes: 1. Caries from external causes; 2. From constitutional disease, in which cases, besides local remedies, it is necessary to employ such medicines as are calculated to obviate the particular affection of the system, whence the diseased state of the bone has originated.

Mr. Mayo enumerates four kinds of caries: 1. *Simple*, When, in a person of sound constitution, a state of unwholesome and protracted inflammation is set up in a bone, through some accidental local cause. 2. *Syphilitic*. When a disposition to a specific periosteal inflammation is produced by lues. 3. *Strumous*. When the scrofulous diathesis gives origin to caries. 4. *Malignant*. When the bones are absorbed in the spread of malignant ulcers. (See *Outlines of Human Pathology*, p. 36.)

But many circumstances, in relation to the varieties of caries, yet lie in obscurity. If, as a modern writer remarks, the situation of the bones, the nature of their organisation, and the slowness of their diseases, would let an attentive observer trace the formation, development, and progress of caries, no doubt there would be noticed a diversity in its symptoms, corresponding to its different species; and, probably, it would be found, that a venereal or scrofulous caries would vary in its origin and progress, as much from a caries arising from a purely local cause, as a venereal or scrofulous ulcer differs from the kind of ulceration that follows a common abscess. (*Dict. des Sciences Méd.* t. iv. p. 84.) The *worm-eaten* caries, as it has been termed, which penetrates the whole substance of a bone, and gives it an appearance as if it had been bored in hundreds of places, is a very different affection from some other forms of the disease, whether superficial, or extending to the deeper texture of the bone.

Around the carious part, there is always a deposit of new osseous matter, in the form of tubercles, extending to a considerable distance, and greatly increasing the thickness of the bone. The new bone, on superficial inspection, appears rough and porous, the pores being for the transmission of blood-vessels.

Mr. Syme regards the distinction of caries into the *dry*, *moist*, *worm-eaten*, &c. only as the result of the confusion of caries with other morbid states of the osseous tissue. The dry is in reality necrosis, as already noticed. A carious bone, after maceration, according to Mr. Syme, looks as if it had been burned; being harder, whiter, and more brittle than usual, and always attended with more or less excavation, so as to expose the cellular structure. It resembles a piece of loaf sugar, that has been partially dissolved by momentary immersion in hot water. According to Mr. Mayo, syphilitic caries begins with inflammation of the periosteum, and " does not lead to much enlargement of the bone. The bones commonly attacked are those, which, lying near the surface, are obnoxious to cold: the tibia, for instance, the ulna, the clavicle, the cranial bones. The swelling, by which syphilitic caries first manifests itself, is called a node. It is an inflammation, either confined to the periosteum, or involving at most the cortex of the bone. The periosteum becomes thickened, and is exquisitely painful. If the integuments are divided down to the bone at this period, a thick, viscid, glary matter, like honey, is often found in the cells of the periosteum, &c. The surface of the bone now gradually enlarges, or is thrown up in particles of porous bone, either furrowed by longitudinal grooves, or spongy and sieve-like, riddled with innumerable minute holes." The outer table of the skull in venereal caries, generally has the appearance of being worm-eaten. Mr. Mayo adds, that, while the caries is making progress, the integuments inflame; and matter forms below the skin, which afterwards ulcerates. The skin before breaking has a livid colour; and afterwards the skin around the ulcer has the same hue. The edges of the sore are commonly a little raised; its outline uneven, and the granulations irregular, and covered by a viscid ash-coloured secretion. A probe readily passes through the soft and gritty texture of the caries. The co-existence of ulcerated fauces and squamous eruption, or other disease of the skin, generally leaves no doubt of the nature of the caries. Sometimes, however, the latter exists alone. (See *Mayo's Outline of Human Pathology*, p. 40.)

Mr. Mayo is unacquainted with any essential difference in the appearance of carious bones in some forms of scrofula, and in the parallel cases dependent upon lues. "Less pain, less periosteal inflammation, and a smaller extent of surface attacked, the absence of other symptoms, and the general physical appearance of the patient (he adds), afford a strong presumption of the scrofulous origin of the disease." (*Op.* cit. p. 41.)

The instances of malignant caries, adduced by Mr. Mayo, are those from lupus and cancer. (p. 48.)

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Abscesses, situated in the vicinity of bones, are frequently thought to be the cause both of necrosis and caries. This was the ancient doctrine, and it has found various advocates in modern times, especially Mr. Liston. (See *Edin. Med. and Surg. Journ.* vol. xx. p. 52.) Hence, the rule to open such abscesses at an early period, in order to prevent the bone from being affected. If some abscesses, like those which form over the anterior surface of the tibia and mastoid process of the temporal bone, be frequently attended either with caries or necrosis, the latter is mostly the cause, and not the effect, of the suppuration. Pus, which is a bland, unctuous, inodorous fluid, never attacks the soft parts, with which it is in contact, until its qualities are changed by exposure to the air. When an abscess forms in the anterior part of the parietes of the abdomen, the peritoneum of that part, naturally a thin membrane, instead of being destroyed, becomes thick, and strong enough to resist the extension of the abscess towards the cavity of the abdomen. So also, when an abscess is formed over a bone, not originally diseased, or hurt by the same causes which produced the abscess, and not injured by being kept exposed, or by astringent escharotic applications, neither caries, nor necrosis, is likely to happen. On the contrary, the periosteum, like the peritoneum, becomes thickened, and granulations are formed over it. In the opinion of Mr. Syme, caries cannot, like necrosis, be induced directly by the effect of violence. It depends, he says, upon a peculiar morbid action, which is probably in all cases preceded by inflammation. "Many people think, that pressure, such as that of an aneurism, causes absorption of bone, and gives rise to an appearance, which might be mistaken for caries by an inexperienced, or careless observer, but could never for a moment impose upon any one acquainted with the distinctive characters of the disease. The surface, exposed by simple absorption, differs in no respect from that which would have appeared if the excavation had been effected by violence. We do not here perceive the hardness, whiteness, and brittleness of caries; neither is there any matter secreted from it; and so soon as the caries is removed, the disease ceases. The effect of pressure in causing absorption without inducing caries, is well seen in those common cases of necrosis, where internal exfoliation occurs, and the confined pus makes a way for its escape, since the sides of these passages, so produced, the cloacæ as they are called, are in no respect carious, or unfit for healthy action. Deep-seated collections of matter ought to be evacuated early to relieve the patient from pain, or prevent extension of the fluid, but no apprehension need be entertained of caries being produced by its pressure." (*Syme*, vol. cit. p. 258.)

But, though Mr. Syme believes, that inflammation generally, if not always, precedes caries, he represents this consequence as not invariably following inflammation, or even suppuration. "In cases of compound fracture, amputation, excision of joints, &c., we every day see bone suppurate and granulate in the most satisfactory manner. We observe the same thing occasionally in joints, which become anchylosed after being the seat of abscess." At the same time, Mr. Syme is of opinion, that suppuration of bone, which either takes place spontaneously, or in consequence of slight external injury, is very frequently followed by caries, much more so, than when it results from a wound, which does not heal by the first intention.

Mr. Syme has found that caries seldom affects the bone to a great depth. "Thus, we often see an articulating extremity carious over its whole external surface, and sound in the centre. At other times, we find it hollowed out into a cavity, the surface of which is carious, while the external shell is sound. The very limited extent of the disease often contrasts remarkably with the extreme obstinacy and severity of the symptoms. Thus, there is in my possession a thigh-bone, which I took from the body of a woman, who had laboured under caries of the trochanter major for thirteen years; yet the whole disease may be covered by the point of a finger, and is not thicker than a sixpence." (*Syme*, in *Edin. Med. Journ.* vol. xxxi. p. 257.)

The venereal disease is sometimes a cause of caries; sometimes of necrosis; frequently of both affections together; and, in other instances, of exostosis. When it attacks the bones of the nose, its destructive effects arise partly from necrosis, and partly from caries, and the face is sadly disfigured. The bones of the palate are sometimes altered in the same manner; but, on other occasions, the effect upon them is chiefly necrosis.

In cases of cancer of the breast, the sternum and ribs are sometimes found carious. I believe, that, in such cases, the disease of the bones has nothing in its own nature entitling it to be regarded as cancerous. It is a mere effect of the original disorder; and if the carious bone could be removed together with every particle of the disease of the soft parts, a cure would probably follow. Or, supposing the carious bone were the only portion of the disease left, it is conceivable that the case might yet end in a cure. At the same time it is proper to recollect, what has been mentioned in the article CANCER, that Sir Astley Cooper refers in his Lectures to some bones, taken from cancerous subjects, where a scirrhous substance has been deposited in their structure.

Caries, arising from syphilis, most commonly affects the tibia, ulna, clavicle, cranium, ossa nasi, ossa palati, and sternum; and, I believe, is often complicated with a greater or less degree of necrosis. Scrofulous caries of the vertebræ is known by peculiar symptoms, among which a paralysis of the inferior extremities, and lumber abscesses, are the most remarkable. Cæteris paribus, caries from an external or a local internal cause, is less dangerous than that, which proceeds from a constitutional disease, particularly when the latter is difficult of cure. Caries of the spongy part of bones is more difficult to cure than a similar affection of their compact parts. Caries of the carpal and tarsal bones is particularly obstinate. These bones being in close contact, the affection cannot easily be prevented from spreading from one to the other. If excision, or extraction of them be impracticable, amputation is often the only means of cure. The same is frequently the case, when the spongy heads of the long bones, forming the large joints, become carious. Even this mode of relief is not practicable when the head of the bone lies very deeply, like that of the os femoris.

Caries from scrofula, the most frequent case, is more difficult of cure than that from syphilis and scurvy; for some efficacious remedies against the latter diseases are known, but scrofula cannot be said to be much within the reach of medicine. The prognosis is less favourable in old than young subjects; and much depends on the extent of the disease, the patient's strength, and the state of the soft parts.

When caries arises from constitutional disease, internal remedies are of course indicated. Thus hydriodate of potash, sarsaparilla, tonics, and sudorific medicines, have a tendency to cure (perhaps even more frequently than mercury) caries from syphilis; while vegetable diet and acids cure both scurvy and the caries dependent on it.

According to writers, the indications in the treatment of caries are, either to produce a change in the action of the diseased portion of bone, whereby it may regain a healthy state, or to destroy it altogether.

In the caries from constitutional causes, the first object seems to be brought about by the operation of such remedies as remove the original disease; and, I should much doubt, whether, in these cases, any very active local treatment is necessary, or free from objection. Of course this remark is meant to apply only to examples, in which we possess some medicine or plan, which is known to be a tolerably sure remedy for the general disease. This is not the case in caries from scrofula, and here issues, blisters, friction, with other local means, are unquestionably advantageous. (See Joints, and Vertebræ.) But surgeons have proceeded further; and not content with issues, blisters, fomentations, &c. as means for quickening the action of the diseased bone, they have commonly recommended applying directly to it the strongest stimulants, as the tincture of aloes or myrrh, a solution of the argentum nitratum, the acetic acid, or diluted muriatic or nitric acid. The actual and potential cauteries, and cutting instruments, have also been employed.

On the Continent, and particularly in France, the plan of touching carious parts of bones with the actual cautery, after bringing them fairly into view by the previous use of the knife, is still pursued. It is thought, that the burning iron acts by changing the caries into a necrosis, irritating the subjacent sound parts, and exciting that action of the vessels, by which the dead or diseased part of the bones must be thrown off. Such is the doctrine inculcated by Boyer, and such is the practice sanctioned by other surgeons of the present day.

Mr. Hey succeeded in cutting away a carious part of the tibia. He began the operation by dissecting off the granulations of flesh, which had arisen from the bone, and then sawed out, by means of a circular-headed saw, a wedge of the tibia, two inches in length. The removal of this portion, brought into view a caries of the cancelli, almost as extensive as the piece already removed. With different trephines, suited to the breadth of the caries, Mr. Hey removed the diseased cancelli of the bone, quite through to the opposite lamella. As the caries extended in various directions, it was not possible to remove the whole of it with a trephine, without removing also a large portion of the sound part of the bone, which Mr. Hey wished to avoid. By the assistance, therefore, of a strong sharp-pointed knife, he pursued the caries in every direction until every part was taken away, which had an unsound appearance. The wound was simply dressed with dry lint; the whole surface was speedily covered with good granulations; and a complete cure was obtained, without any exfoliation.

Mr. Hey concludes this subject as follows: "I have treated some other cases of caries of the tibia in the same manner, and with equal success. Where the extent of the caries is not so great as to prevent a complete removal of the morbid part, this method is extremely useful, and far superior to the use of the potential or actual cautery.

"The trephine is not wanted where the cancelli of the bone are not affected with the caries. The diseased parts of the lamella may be removed with gouges or small chisels. Granulations of flesh will then arise from the sound parts of the bone, and become united with the integuments, which ought to be preserved as far as is possible." (*Pract. Obs. on Surgery.*)

Mr. Syme also regards excision as the best method of destroying carious bone, since (he says) "more can be done by the gouge or cutting pliers, in a few seconds, than by the actual cautery in as many weeks, or months;" but he strongly objects to the application of the cautery to the bone afer the excision of the carious part. *Edin. Med. Journ.* vol. xxxi. p. 260.) On this point, every judicious surgeon must, I think, agree with him.

Dr. Nicol, surgeon to the Northern Infirmary of Inverness, has published the result of his experience in caries; and he finds that, when excision is not practicable, the next most effectual treatment consists in applying nitrate of silver to the carious part, and exhibiting the compound decoction of sarsaparilla. (See *Edin. Med. and Surg. Journ.* No. xciv.)

In the treatment of caries, particularly of that form of it which accompanies white swellings, Mr. Liston considers ointments and poultices as unlikely to be productive of much good. In the first or inflammatory stage, he praises topical bleeding, practised with moderation, and followed by issues, sinapisms, blisters, or the antimonial ointment. However, he thinks the most effectual remedy is the moxa. "In all deep-seated pains of the joints (says Mr. Liston) this remedy affords the most speedy and complete relief, at the expense but of a trifling pain, of no long duration. The pain does not appear to be greater, than that arising from the formation of an eschar by potass, or any other of the potential cauteries, and lasts only during the time of the application, whilst the violent pain does not subside, perhaps, for twelve hours after the employment of the potass." (*Edin. Med. and Surg. Journ.* No. lxxviii. p. 54.)

When caries is fairly established, and the integuments have given way, the same author represents the indications to be either the immediate removal of the diseased bone, or the employment of means calculated to make it be thrown off by the constitution. "The first indication (he says) is to be accomplished, by the proper use of trephines, perforators, gouges, gravers, scoops, saws, and forceps of different kinds, for dividing or extracting; the second, by cauteries, actual or potential. In general, a combination of both is required.

"In caries of the long bones, it becomes in general necessary to enlarge the opening through the outer lamella, by the application of the trephine, and perhaps by the use of a small saw, or cutting forceps, so as to connect the different perforations, and thus obtain access to the diseased cancelli. The scoop, or graver, will answer well for the rest of the work. In most instances the actual cautery is next applied very freely, by which means the whole of the diseased surface will be thrown off, and healthy granulations fill up the breach." (*Op.* cit. p. 56.)

In the Medico-Chirurgical Trans. cases have been recorded by Mr. Dunn and Mr. A. C. Hutchison, in which several of the tarsal bones in a state of caries were cut out, and the foot preserved. The same practice seems to be followed by Mr. Liston, with the addition of the cautery. He observes, that when the disease is seated in one of the tarsal, or carpal bones, and entirely limited to it, its simple removal will be sufficient. But when one is quite destroyed, and the surfaces of others with which it is articulated are affected, these surfaces must also be cut out, and *the operation finished by the free application of the cautery*. The principle which Mr. Liston lays down is, that *the cautery is indispensable, whenever the cancellated texture of a bone is encroached upon*. The knife for such operations, he says, should have a strong sharp point and edge, with a thick back and firm handle. A scoop, graver, or gouge, and strong pliers, with some pairs of cutting forceps, will (with the cauteries for such cases as require them) complete the apparatus. The bone-forceps, with the cutting edges in a line with the handles, as used by Mr. Liston for some years, are strongly commended, more especially when the metacarpal or metatarsal bones are to be in part removed. In these operations Mr. Liston has never found saws of the least use; and in several trials of the chain saw, which he witnessed, it either broke, or got so wedged, that great difficulty was experienced in disengaging it and bringing the operation to a conclusion. He does not approve of the half-headed trephine, because the bone must be denuded much higher than where the division is to be made, in order to let the centre-pin be fixed. The annular saw, he also disapproves of, on account of the extensive division of the integuments, which its use requires. He does not enter into any particular reasons against Hey's saws, which have been found so useful by other practitioners; and the rotation saw lately invented by Professor Thal, of Copenhagen, is mentioned, but its merits not examined. In short, whatever some surgeons would execute with a saw in the operations under consideration, Mr. Liston would perform with his bone-forceps, or cutting pliers, and other means. The facts which he has reported, show clearly enough, that the forceps used by him, is a very efficient instrument; and it is no slight circumstance in its favour, that Baron Dupuytren strongly commends it, and has publicly used it. (*Liston*, in *Edin. Med. and Surg. Journ.* No. lxxviii.) I have also tried it in the North London Hospital with great advantage.

(See *J. L. Petit*, Traité des Mal. des Os. Paris, 1741. *A. Monro*, in Edin. Med. Essays, vol. 5. *Weidmann*, De Necrosi Ossium, Francof. 1793. *Callisen*, Systema Chirurgiæ Hodiernæ, vol. i. p. 493. *Boyer*, Traité des Maladies Chir. t. iii. p. 453, et seq. Paris, 1814. Dict. des Sciences Méd. t. iv. p. 78, &c. *J Wilson*, on the Structure, Physiology, and Diseases of the Bones, &c. p. 263, 8vo. Lond. 1820. *L. Wissmann*, De Rite Cognoscendis et Curandis Nudatione, Carie et Necrosi Ossium, 8vo. *R. Liston*, Essay on Caries, in Edin. Med. and Surg. Journ. No. 78. *B. Bell*, on Diseases of the Bones, chap. 2. 12mo. Edinb. 1828. *Herbert Mayo*'s Outlines of Human Pathology, sect. vii. p. 36. 8vo. Lond. 1835.

CARTILAGES, ULCERATION OF. See JOINTS.

CASTRATION. The operation of removing a testicle. For an account of the cases rendering this measure necessary, see TESTICLE, DISEASES OF. The manner of operating is as follows:—The patient being laid on a table of convenient height, the first incision should begin, as nearly as possible, opposite to the abdominal ring, and be continued at least to the bottom of the scrotum.

The manner of beginning this incision is differently described by writers: some of them advising that the skin be held up by an assistant; others, that the knife be used perpendicularly in this as in other parts. The latter mode is generally preferred by English surgeons. The length of the division is a more important consideration. A small wound will indeed serve to lay bare the spermatic chord; but it will not permit the operator to do what is necessary afterwards with dexterity or facility; and as the scrotum must, either at first or at last, be divided nearly to the bottom, it had better be done at first.

Dupuytren recommends it to be carried also a little further, in the direction backwards. "In scirrhous cases (says he), not only is the testicle affected, but often a portion of the spermatic chord. It is therefore for the purpose of following up the diseased parts, that the incision is extended up to the abdominal ring. It is carried down the whole length of the organ, in order that this may be removed entire from the scrotum; for, if the opening were only two or three inches long, the testis could not be easily drawn out, and the dissection would be extremely painful. The intention of prolonging the incision backwards is not less obvious; if this were not attended to, the scrotum would retract, and form a sac, in which the pus would accumulate." (See *Dupuytren*, *Clin. Chir.* t. i. p. 91.)

The spermatic chord is next to be laid bare by another incision. If the external pudendal artery is divided, the bleeding from it may be checked by an assistant putting his finger on it. The spermatic chord having been detached from its surrounding connections, the operator, instead of putting a ligature round it, which is an excessively painful proceeding, should first transfix it with a tenaculum, so as to hinder its retraction within the abdominal ring; then divide it just below the tenaculum with the scalpel; and next tie the arteries of the chord as separately as possible from the rest of it. This plan, which has long been adopted by the best surgeons in London, was also preferred by Dupuytren. (See *Clin. Chir.* t. i. p. 94.) Then the testicle is to be dissected out from its connection with the scrotum: the loose texture of the connecting cellular substance, the previous separation of the testicle from the spermatic chord, and the help of an assistant to hold up the lips of the wound, will enable the surgeon to do this with great facility, particularly if he takes hold of the chord, and draws the testicle outward by means of it. As Dupuytren directs, all the cellular tissue around the testicle and chord, the tunica vaginalis, and even the cremaster, should be taken away. Before the chord is cut, it should be carefully examined, lest the incision be made so low, as to leave some of the disease behind. (See *Dupuytren, Clin. Chir.* t. i. p. 92.) In dissecting out a large testis, care must be taken not to wound the urethra, corpora cavernosa, nor the testis of the opposite side.

Mr. S. Sharp once castrated a man whose testicle weighed above three pounds; and some of the vessels were so varicose and dilated, as nearly to equal the size of the humeral artery. (*Operations of Surgery*, chap. x.)

Desault first divides the chord, and, holding its upper end between the index finger and thumb of his left hand, he then takes up the arteries with a pair of forceps, and they are immediately tied by an assistant. (*Œuvres Chir. par Bichat*, t. ii.) The spermatic artery will be found in the anterior part of the chord; and as soon as this vessel has been tied, the surgeon is to secure another, which accompanies the vas deferens, the latter part being carefully excluded from the ligature. (See *Sir A. Cooper's Lectures, &c.* vol. ii. p. 161.)

The spermatic artery, and any scrotal vessels which require to be taken up, should be tied with fine silk ligatures, as recommended by my friend Mr. Lawrence. (See *Med. Chir. Trans.* vol. vi. p. 197.)

Pott used to fill the cavity of the wound with lint; but Desault and all the modern surgeons of this country bring the edges of the wound together, and endeavour to heal as much of it as possible by the first intention.

The plan of dressing, adopted by Mr. Lawrence, consists in retaining the edges of the skin together with two or three sutures, and then applying a narrow strip of simple dressing. A folded cloth, kept constantly damp, is also laid over the wound. (*Med. Chir. Trans.* vol. vi. loc. cit.) Sir A. Cooper also employs two sutures: one, opposite the end of the chord; the other, at the mid-point between the first suture and the termination of the incision. (*Lectures, &c.* vol. ii. p. 161.)

The main reasons, stated by M. Roux, for not bringing the wound together, are that secondary hemorrhage cannot be well guarded against, except by filling the part with charpie; that the redundance and looseness of the skin render it difficult to keep its edges in exact contact, without removing a portion of it, and using sutures, which are objectionable; and that suppuration cannot commonly be prevented, because there is a large quantity of loose cellular substance in the wound, which substance readily suppurates. (*Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise, &c.* p. 119, &c.) By applying cold water and gentle compression to the part, I believe, however, such hemorrhage may generally be averted, and the union of the wound materially expedited. As a judicious writer observes:—"In the London hospitals, complete union by the first intention is seldom or never accomplished: yet, by attempting it, the wound is much diminished, and the cure of it rarely delayed later than three or four weeks; whereas the wound, when stuffed with lint, is usually not healed in less than seven or eight weeks." (See *Sketches of the Medical Schools of Paris*, by *J. Cross*, p. 144.)

After castration, the edges of the scrotum separate and become inverted, so that, if brought together, only the skin covering them is in apposition. Hence, as Dupuytren has explained, one reason for sutures, with which he imitated English surgeons in endeavouring to unite as much of the wound as he could. (See *Clin. Chir.* t. i. p. 94.)

Sometimes, one or more vessels begin to bleed soon after the patient is in bed, although they effused no blood just after the removal of the testicle. Keeping the dressings and scrotum continually wet with the cold saturnine lotion very often suffices for the prevention and suppression of such hemorrhage: if not, the wound must be opened again, and the vessels tied.

J. L. Petit made some useful remarks on this operation. The vessels of the scrotum, says he, are not the only ones, which may be the source of hemorrhage. Anatomists know, that the septum which divides this part into two cavities, is furnished with an artery, that is not considerable, but which becomes materially enlarged in the case of a sarcocele or other tumour. It is sometimes so considerable, that it causes a bleeding, which makes a surgeon, who has had no previous opportunity of seeing the occurrence, exceedingly uneasy. Such hemorrhage, says Petit, may be easily suppressed with a ligature; and he assures us, that he has seen a surgeon dress the patient three times, without ever suspecting that the bleeding, for which the applications were a third time removed, proceeded from this artery. (*Maladies Chir.* t. ii. p. 524, 525.)

The same experienced surgeon also acquaints us, that he has more than once extricated from trouble persons, who knew not how to stop the bleeding after the operation. He has seen some of them take off the dressings several times without discovering the wounded vessel. As they imagined, that the only hemorrhage which could follow castration must be from the spermatic artery, they contented themselves with examining the ligature on the chord, and increasing the compression, in order to stop the bleeding; but finding their attempts fail, they were compelled to seek assistance. On being sent for, M. Petit found, that the blood did not issue from the chord, but from a small artery under the skin, at the inferior angle of the wound. He easily stopped the hemorrhage, and explained, not only that the chord had no share in the accident, but that it is generally suspected without foundation.

In general, after the removal of a diseased testis, there is more risk of bleeding from the vessels of the scrotum than those of the chord. I have never seen hemorrhage from the spermatic artery give trouble after the operation, but have often known surgeons obliged to take off the dressings on account of bleeding in the scrotum. I believe the most likely way of avoiding this disagreeable occurrence is to imitate Mr. Tyrell, "always to allow the patient to become warm in bed before the dressing is completed;" for, until this period, it is not known what vessels in the scrotum will bleed. (See *Sir A. Cooper's Lectures, &c.* vol. ii. p. 161.)

When the diseased testicle is exceedingly large, or a part of the scrotum is diseased, the surgeon should take care to remove the redundant or morbid portion of the skin, by including the piece, which he designs to take away, within two long elliptical incisions, which are to meet at the upper and lower parts of the swelling. In this manner, as Mr. Samuel Sharp has observed, the hemorrhage will be much less, the operation greatly shortened, the sloughing of the distended skin prevented, and the recurrence of cancerous disease rendered less likely. (See *Treatise of the Operations*, chap. x.)

Mr. Lawrence concurs with M. de la Faye in thinking it best always to remove a large piece of the scrotum with the testicle, by which means the surface of the wound is lessened. (See *Med. Chir. Trans.* vol. vi. p. 196.) Sir Astley Cooper approves of the practice when inflammation has rendered the testicle adherent to the scrotum, as being preferable to a tedious and painful dissection for the separation of the parts. (See *Lectures, &c.* vol. ii. p. 160.)

If the tumour be of a pyriform figure, perfectly smooth and equal in its surface, and free from pain, notwithstanding the degree of hardness may be great, and the surgeon may, in his own opinion, be clear, that the tumour is not produced by fluid, but is a true scirrhus, it is an excellent rule to make a small opening through the scrotum into the fore part of the tunica vaginalis, previously to the commencement of the operation, as recommended by Mr. Pott, so that if the case be one of serum or blood, its nature may be ascertained, and perhaps the testicle saved. "My reason for giving this advice (says Pott) is, that I was once so deceived by every apparent circumstance of a true, equal, indolent scirrhus, that I removed a testicle, which proved upon examination to be so little diseased, that, had I pierced it with a trocar previous to the operation, I could, and certainly should, have preserved it." J. Cloquet has seen castration performed in two instances of simple hydrocele, accompanied with great tension, but presenting no transparency nor manifest fluctuation. (*Pathologie Chir.* p. 45.)

The best way is to make a small opening with a lancet or knife; and not to introduce a trocar in the manner advised by Pott, because it would be highly censurable to injure the testicle, and put the patient to unnecessary pain, even though that organ might be found diseased, and to require removal.

The agony of tying the chord is immensely increased by including the vas deferens; and, as no good results from so doing, the practice should be renounced in every part of the world, as it long has been in this metropolis.

Cases are recorded, in which the inclusion of the whole of the spermatic chord appears to have occasioned severe and perilous consequences, and these in so great a degree, that it was found necessary to cut and remove the ligature. Sometimes, says Petit, patients on whom castration has been performed, suffer more or less acute pain in the kidneys. The suffering often becomes insupportable and highly dangerous, the belly being swelled, tense, and painful; the patient being affected with syncopes, and affections of the heart, sometimes with vomiting, and a retention of urine: lastly, a universal inflammation of the belly, and a violent fever, accompanied with delirium, are occasionally the fatal consequences of this operation. Petit was required to visit a patient, who had been in this deplorable state for twenty-four hours, after having suffered castration, and this distinguished surgeon could impute the sudden and violent symptoms to nothing except the ligature on the spermatic chord; consequently, he advised the ligature to be removed. The patient received some slight relief from this step; and, after having been bled twice within a short space of time, he found himself a great deal better; but, as the dressings became wet with blood, apprehension of bleeding began to be entertained. Petit, therefore, had recourse to moderate compression of the chord. No hemorrhage ensued; the case afterwards went on well; and the patient recovered sooner than was expected. (*Traité des Maladies Chir.* t. ii. p. 527, 528.)

In the operation of removing a testicle, one caution seems particularly necessary, viz. if the chord should be at all enlarged, the surgeon ought carefully to examine, whether the augmentation of its size may not be owing to a portion of intestine, or omentum, that is contained within it. (*Sabatier, Médicine Opératoire*, t. i. p. 332. édit. 1.) In one case of extirpation of the testicle, "after the operation was completed, and the wound dressed, the patient being seized with a fit of coughing, to the astonishment and dismay of the surgeon, the dressings were forced off by a protrusion of several convolutions of small intestines: from this, it was proved that the patient had had a hernia; but, the diseased enlargement of the testicle had acted as a truss, and prevented the rupture from coming down." (See *Operative Surgery*, by *Sir C. Bell*, vol. i. p. 226.; also p. 224.)

Another circumstance merits attention: when there are reasons which oblige us to divide the chord high up, and this part has not been tied before such division is made, it may be drawn up by the cremaster within the abdominal ring, and some difficulty may be experienced in securing the spermatic arteries. Sir C. Bell saw this happen twice, and the patients lost their lives from hemorrhage. Hence, when it is necessary to cut through the chord near the ring, it is best always to transfix it with a tenaculum first, as above recommended. However, were the chord to happen in any instance to be drawn up within the ring, a surgeon would be guilty of most supine neglect to let the patient die of bleeding; for, as Sir C. Bell has remarked, we may follow the chord with perfect safety, even to the origin of the cremaster, which pulls it up, if attention be paid to the course of the chord, obliquely upward and outward, within the inguinal canal. Mr. Cline was present at the removal of a testicle, after which the chord could not be found; he therefore slit up the inguinal canal, and brought it into view again. In order to avoid this inconvenience, Sir Astley Cooper approves of the practice of passing a temporary ligature through the chord, as soon as it has been exposed. (See *Lectures, &c.* vol. ii. p. 61.) Either this expedient, or that of the tenaculum, is unquestionably prudent.

A few years ago, the operation for a bubonocele was performed, and as the testicle was found diseased, the surgeon made a complete division of the spermatic chord, tied the spermatic arteries, and then left the testicle in its natural situation. After a time, the absorbents had diminished the part to a very small inconsiderable tumour. (*H. Weinhold*, in *Journ. der Pract. Heilkunde von C. W. Hufeland und K. Himly*, 1812, *zehntes stück*, p. 112.) This case merits attention, because it is the first instance, I believe, in which such practice was ever tried. Subsequently, the following work was published: — *Nouvelle Méthode de traiter le Sarcocele, sans avoir recours à l'Extirpation du Testicule; par C. Th. Maunoir*, 8vo. Génève, 1820. The new plan consists in dividing and tying the spermatic arteries, and leaving the rest of the chord and the testis undisturbed. Instead of this plan, another has been proposed, which consists in merely removing an inch or two of the vas deferens from the chord. I do not find that these methods have yet been established.

When disease, not merely an œdematous swelling, extends far up the chord, Pott considered castration as too late. In such cases Lisfranc has seen Dubois pull down the chord and then divide it, and Baron Dupuytren cut up the inguinal canal to the internal ring; but all the patients died. (*C. Averil, Operative Surgery*, p. 103. Lond. 1823.)

In one instance, I removed a testis for medullary disease, and observed in the part of the chord removed little white bodies, like millet seeds in size and shape. This led me to apprehend a relapse, but the patient has continued well for some years. In the North London Hospital, I removed another testis, for the same kind of disease; but I fear that the patient will ultimately die of another medullary tumour in the abdomen.

See *Sharp*'s Operations of Surgery, chap. x. *Pott* on the Hydrocele, &c. *Sabatier*, De la Méd. Opér. tom. i. *Bertrandi*, Traité des Opér. de Chirurgie, chap. xi. Œuvres Chir. de Desault, par *Bichat*, tom. ii. p. 449. *Larrey*, Mém. de Chirurgie Militaire, tom. iii. p. 423, &c. *John Pearson* on Cancerous Complaints. *J. L. Petit*, Traité des Malades Chir. tom. ii. p. 519, &c. *Sir C. Bell*'s Operative Surgery, vol. i. *Roux*, Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise, p. 119, &c. *Lawrence*, in Med. Chir. Trans. vol. vi. p. 196, 197. Sketches of the Medical Schools of Paris, by *J. Green Crosse*, p. 139, &c. *Sir A. Cooper*'s Lectures on the Principles and Practice of Surgery, vol. ii. p. 159. 8vo. Lond. 1825. *Baron Depuytren*, Leçons Orales de Clinique Chir. t. iv. p. 109, &c. 8vo. Paris, 1834. *A. L. M. Velpeau*, Nouveaux Elém. de Méd. Opérat. t. iii. p. 537. 8vo. Paris, 1832. *J. F. Malgaigne*, Manuel de Méd. Opérat. p. 621.

CATAPLASMA ACETI. Made by mixing a sufficient quantity of vinegar with either oatmeal, linseed meal, or bread crumb. When linseed is employed, it is best to add a little oatmeal or bread crumb, in order to keep the poultice from becoming hard. The vinegar poultice is generally applied cold, and is principally used in cases of bruises and sprains.

CATAPLASMA ACETOSÆ. *Sorrel Poultice.* ℞ *Acetosæ* ℔ j. To be beaten in a mortar into a pulp.

CATAPLASMA ALUMINIS. Made by stirring the whites of two eggs with a bit of alum, till they are coagulated. In cases of chronic and purulent ophthalmy it has been applied to the eye, between two bits of rag; and it has been praised as a good application to chilblains which are not broken.

CATAPLASMA BYNES. (Malt.) ℞ *Farinæ Bynes, Spumæ Cerivisiæ*, q. s. This is applied to gangrenous and ill-conditioned extending sores. It operates as a gentle stimulus, and as a corrector of fetid effluvia.

CATAPLASMA CARBONIS. Made by mixing powdered charcoal with linseed meal and warm water, and applied to improve the condition of several kinds of unhealthy sores.

CATAPLASMA CERIVISIÆ. Made by stirring some oatmeal, or linseed meal, in strong beer grounds. It is used in the same cases as the Cataplasma Fermenti, and Cataplasma Bynes.

CATAPLASMA CONII. ℞ *Herbæ circutæ exfoliatæ* ℥ ij. *Aquæ fontanæ* ℔ ij. To be boiled till only a pint remains, when as much linseed meal as necessary is to be added.

Hemlock poultice is an application for cancerous, scrofulous, and other ill-conditioned ulcers, frequently producing a great diminution of the pain of such diseases, and improving their appearance. Justamond preferred the fresh herb bruised. A solution of the extract is sometimes added to a bread and water poultice.

CATAPLASMA DAUCI. Some bruise the carrots in a mortar into a pulp; while others first boil them. Carrot poultice is employed as an application to ulcerated cancers, scrofulous sores, and various inveterate ulcers.

CATAPLASMA DIGITALIS. Made by mixing linseed meal with a decoction of the leaves of the plant. It is adapted to the same cases as the cicuta poultice.

CATAPLASMA FARINACEUM. The bread and milk poultice, made by putting some slices of bread-crumb in milk, and letting them gently simmer over the fire in a saucepan, till they are properly softened. The mass is then to be mixed and stirred about with a spoon, and spread on linen.

CATAPLASMA FERMENTI. *Fermenting Poultice.* ℞ *Farinæ Tritici*, ℔ j. *Cerevisiæ Spumæ, Yest dictæ*, ℔ ss. These are to be mixed together and exposed to a moderate heat till the effervescence begins. In cases of sloughing, and many ill-conditioned ulcers, this is an application of great repute.

CATAPLASMA LINI. *Linseed Poultice.* ℞ *Farinæ Lini* ℔ ss. *Aq. Ferventis* ℔ iss. The powder is to be gradually sprinkled into the hot water, while they are quickly blended together with a spoon.

This is one of the best and most convenient of all the emollient poultices for common cases, and it has nearly superseded that of bread and milk, which was formerly much more frequently employed.

Mr. Hunter speaks in the following terms, of the linseed poultice, and its uses: —

"Poultices are commonly made *too thin;* by which means the least pressure, or their own gravity, removes them from the part: they should be thick enough to support a certain form when applied.

"They are generally made of *stale* bread and milk. This composition, in general, makes too *brittle* an application; it breaks easily into different portions from the least motion, and often leaves some part of the wound uncovered, which is frustrating the first intention.

"The poultice, which makes the best application, and continues most nearly the same between each dressing, is that formed of the meal of linseed; it is made at once, and when applied it keeps always in one mass.

"The kind of wound to which the above application is best adapted, is one made in a sound part, which we intend shall heal by granulation, The same application is equally proper when parts are deprived of life, and consequently will slough. It is therefore the very best dressing for a *gunshot* wound, and probably for most *lacerated wounds;* for *lint,* applied to a part that is to throw off a *slough,* will often be retained till that slough is separated, which will be for eight, ten, or more days."

CATAPLASMA MURIATIS SODÆ. ℞ *Pulveris Lini, Micæ Panis, āā. partes æquales. Aq. Sodæ Muriatæ* q. s. This is used for diminishing scrofulous tumours and glands. When it excites too much irritation in the skin, a linseed poultice may be substituted for it until this state has subsided.

CATAPLASMA PLUMBI SUBACETATIS.

℞ Liquoris Plumbi Subacetatis drach. j.
Aquæ distillatæ lib. j.
Micæ panis q. s. — Misce.

Practitioners, who place much confidence in the virtues of lead, externally applied, often use this poultice either in a warm or cold state.

CATAPLASMA QUERCUS MARINI.

This is prepared by bruising a quantity of the marine plant commonly called *sea tang.* The poultice, thus made, has been occasionly applied to scrofulous abscesses, glandular swellings, and diseased joints. I rarely hear of its being employed at the present day.

CATARACT. (From *καταράσσω,* to confound or disturb; because the disease confounds or destroys vision. *Γλαύκωμαὑπόρχυμα. Gutta opaca. Suffusio. Der Graue Staar.*) Is usually defined to be a weakness or impediment of sight, produced by opacity of the crystalline lens, or its capsule. Professor Beer applies the term to every perceptible obstacle to vision, situated in the posterior chamber, between the vitreous humour and the uvea. (*Lehre von den Augenkrankheiten,* b. ii. p. 279. 8vo. Wien, 1817.)

A cataract is also described as a partial or general opacity, of the crystalline lens, of its capsule, or of the fluid of Morgagni, with a corresponding diminution of sight. "The most striking circumstances observable in cataract (says Mr. Lawrence), are an opaque body placed behind, or even filling up the pupil, and the impaired state of vision which is the result of that change. In both these respects it agrees, in its incipient stage, with glaucoma and some forms of amaurosis; but as the treatment is essentially different in these several affections, it is necessary to discriminate them accurately. In incipient cataract, we can do little or nothing; we must wait until the opacity has become complete, before we perform an operation; but active measures must be resorted to in the earliest stage of amaurosis: if we should leave the case to itself under the supposition of its being cataract, loss of sight would be inevitable and irremediable." (See *Lawrence on Dis. of the Eye,* p. 397.)

Hippocrates and the ancient Greeks described the cataract as a disease of the crystalline lens, under the name of *γλαύκωμα;* but no sooner had Galen promulgated the doctrine of the lens being the immediate organ of sight, than the correct opinion of the ancient founder of medicine began to decline, and, for many ages afterwards, had no influence in practice. In fact, the seat of the cataract was entirely forgotten till about 1656, when first Lasnier, and, afterwards Borel, Bonetus, Blegny, Geoffroi, &c., revived the truth, which had been so long extinct; and they and a few others believed that the disease was situated in the crystalline lens. The bulk of practitioners, however, remained ignorant of this fact even as late as the beginning of the eighteenth century, when the several publications of Maître-Jan, Brisseau, St. Ives, and Heister, combined to render the truth universally known. In 1708, M. Mery, who had hitherto joined in the belief, that the cataract was not a disease of the lens, communicated to the Academy of Sciences, a memoir, in which he acknowledges the correctness of the statement made by Brisseau and Maître-Jan, that vision can take place without the assistance of the crystalline lens; and he recommended a clergyman who had a cataract to have the lens extracted, which was successfully done by M. Petit.

A cataract, even in its highest degree, does not always produce complete blindness. For the mos part, its formation takes place slowly; the cases in which it originates quickly being but few, and those, in which it is suddenly produced in a complete form, still more unusual.

When a cataract is slowly formed: 1. All objects, especially white ones, seem to the patient to be covered by a thin smutty or dusty cloud, which is generally perceived before any opacity is visible in the pupil. 2. The decline of vision bears an exact proportion to the increasing opacity distinguishable behind the pupil. 3. In most cases, the opacity is first discerned behind the pupil, most plainly also at the central point; the instances in which it first presents itself at the edge of the pupil being less frequent. 4. In eyes with a light-coloured iris, the greater progress a cataract makes, the more clearly can one perceive at the edge of the pupil a blackish ring, which partly arises from the shadow of the iris falling on the cataract, but chiefly from the dark-coloured pupillary edge of the iris, which, in a clear pupil, cannot be seen, but now that a greyish surface lies behind it, is rendered very manifest. (See *Beer's Lehre, &c.* vol. ii. p. 281.) This blackish ring is perfectly evident in cases of soft cataracts, and arises from the back of the pupillary edge of the iris being pushed forward by the size of the lens. But if the dilatation be increased to its full extent by the application of the extract of belladonna, an internal blacker circle will be seen to surround the turbid part behind the iris, and the patient sees better for a short time. (*Guthrie's Operative Surgery of the Eye*, p. 197.) The account given of this black circle by Mr. Middlemore differs from that of the latter writer: — "When the cataract is of a light colour (says he) and is not in immediate contact with the iris, a black ring may be seen upon its surface, which will vary in breadth according to the distance at which the anterior capsule may be placed from the iris, and in intensity and distinctness, in proportion to the intensity of the colour of the cataract. This black ring is merely a shadow from the neural aspect of the iris (the uvea), thrown upon the light-coloured surface which is situated near to it, and is always less in the diameter of its inner circle than the pupil. *It is, of course, much broader, and more distinctly seen in hard than in soft cataract*, presuming the colour of both to be the same, and is *not noticed* at all, when, from the peculiar softness of the opaque lens, it is in close contact with the iris. It is scarcely to be observed when the cataract is of an unusually deep or dark brown colour." (See *Middlemore on Dis. of the Eye*, vol. ii. p. 77.) 5. As a cataract generally begins at the central point behind the pupil, such objects as are placed directly in front of the eye, are most difficultly seen, even in the early stage of the disease; but those which are laterally placed, especially when the light is not too strong, and of course the pupil a good deal dilated, can yet be seen tolerably well. 6. Hence, when the opacity, at the central point behind the pupil, is at all considerable, the patient is completely blind in a strong light, while, on the contrary, in a moderately dark room, a degree of vision is yet enjoyed. When the opacity is not far advanced, the eyesight may be improved for a short time, by the patient's turning his back to the light. Belladonna, by increasing the size of the pupil, is of service, and by means of it, "the patient may be conducted, with comparative comfort, through that stage of the disease which intervenes between a moderate defect of vision and the period of the operation. I know (continues Mr. Middlemore) that some surgeons object to its continued use; they say, that its prolonged employment induces a torpid state of the retina, the susceptibility of which becomes permanently diminished under its influence; but, although it has been used under my observation in these and other cases very extensively, and for a long period, I do not remember to have witnessed a single instance, tending in the slightest degree to confirm this opinion." (See *Middlemore on Dis. of the Eye*, vol. ii. p. 77.) 7. Persons with incipient cataracts derive palliative aid from the use of convex glasses, because objects are magnified by them; but they only answer while the opacity is inconsiderable. 8. To such patients the flame of a candle seems to be enveloped in a whitish misty halo, which always becomes broader, the further the patient is from the light. "A candle or street lamp seems expanded into a large globe of weaker light; it looks, to use the phrase of a countryman at the Glasgow Eye Infirmary, as if every lamp was as big as a corn-sieve." (See *Mackenzie on Dis. of the Eye*, p. 673.) When the cataract is far advanced, the flame of the candle cannot be seen, and the patient can only indicate the place near which the light is, or say whether it is close, or at a distance. 9. A cataract which forms slowly, produces, in the course of its progress, no change in the mobility of the iris; and if this effect sometimes takes place when the disease is completely developed, the nature of the case is now so manifest, that no surgeon is in any danger of mistaking the complaint for amaurosis.

The characteristic appearances of amaurosis are entirely different. 1. The opacity, perceptible behind the pupil, is at a considerable distance from this opening, as may be best seen when the eye is viewed sideways. 2. The opacity is somewhat concave. 3. Its colour inclines rather to a greenish or reddish cast, than to grey, or a milk and water colour, which last, according to Dr. Mackenzie, incipient cataract always exhibits. (*Op. cit.* p. 674.) 4. The decline of the eyesight is not at all in a ratio to the degree of opacity, for the patient may be almost blind, though there may be only a slight greenish discolouration of the pupil, very inadequate to account for the injury of vision. 5. The pupil is more or less dilated; the iris sluggish or motionless, its pupillary edge not exactly circular, sometimes angular. 6. Even the cornea itself, is not quite so clear and transparent as in the natural state. 7. The temporary increase or diminution of blindness, so common in patients with incomplete amaurosis, never depends, as in those with cataracts, upon the degree of dilatation of the pupil, but upon causes, which tend either to depress, or excite the system, or upon the degree of light. In general, where vision begins to fail from diminished sensibility of the retina, the patient courts a strong light, and when he attempts to read by candle-light, he brings the book as close as he can to the candle. His period of most distinct vision is noonday, when objects are most brilliantly illuminated by the sun. This is the very time when the cataract patient sees worst. (See *Mackenzie on Dis. of the Eye*, p. 673.) 8. The halo, which amaurotic patients perceive around the flame of a candle is not like a whitish cloud, but has all the hues of the rainbow: indeed, the flame itself presents these colours, and when the patient goes to some distance from it, it generally seems split, or the rays are scattered like those of a star. 9. At no period of the complaint are spectacles of any service, in enabling the patient to see better. In general, objects situated to one side, cannot be seen more plainly, than those which are directly in front of the eye. (See *Beer's Lehre von den Augenkr.* b. ii. pp. 281—284.) To this statement, however, there are exceptions; for, in some instances, where the sensibility of the retina is beginning to diminish, or even where amaurosis is advanced, the patients see objects placed to one side, better than such as are directly before the eye. (See *Mackenzie on Dis. of the Eye*, p. 673.; *Hey*, in *Med. Obs. and Inq.* vol. v. p. 27. 8vo. Lond. 1776.) 10. The sight is not temporarily improved by the application of belladonna. (See *Guthrie's Operative Surgery of the Eye*, p. 212.)

For the difference between cataract and glaucoma, see Glaucoma.

In doubtful cases, the nature of the affection is sometimes elucidated by its history. Cataract forms without any uneasiness in the eye or head, or any disturbance of the health. Glaucoma and amaurosis are often preceded and accompanied by various uneasy sensations, and functional disorder. (See *Lawrence on Dis. of the Eye*, p. 399.)

A positive opinion on the existence of cataract should never be given, without dilating the pupil with belladonna, so as to bring the whole field of disease into view. "It is important also to observe the degree of celerity with which the pupil yields to the influence of belladonna. If the retina is sound, in half an hour the pupil is generally widely dilated; in an amaurotic eye, there is often very little dilatation, at the end of twenty-four hours." (See *Mackenzie on Dis. of the Eye*, p. 677.) The extract of belladonna, dissolved in water to the consistence of cream, may be rubbed on the forehead and eyebrow; or a little more diluted, may be dropped into the eye. Under its influence (says another writer), the pupil becomes fully dilated, "in the course of an hour or two; or if otherwise, the application may be repeated once or twice in the day, for further examination on the subsequent morning. The pupil will now be either fully dilated, or the points of its adherence will be clearly demonstrated, by their remaining fixed, whilst the rest of the pupil yields, the salient points being thereby exposed; or the pupil will remain permanently fixed, showing the attachment of the whole internal surface to the capsule of the lens; or it will remain immovable, whilst the distance between it and the opacity can be distinctly perceived to be as great, or even greater, than natural; the iris inclining backwards, under which circumstances it will in general be tremulous. These parts, as well as the surface of the lens, should now be examined with a magnifying glass." (See *Guthrie on Extraction of the Cataract*, p. 3.) In speaking of the advantages of dilating the pupil with belladonna, stramonium, or hyosciamus, another modern writer remarks:—"This will enable us to detect the characters of the opaque lens, as regards its colour, its consistence, and the seat and extent of the opacity much better than where we have not this advantage; and it will also assist us in ascertaining the true state of the retina; and, as regards the iris, whether or not it has acquired any morbid adhesions, and, if any, their nature, their seat, and extent, and also (what is of great moment) how far the pupil retains the capacity of being dilated by artificial means. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 73.)

The obstacle to vision, situated in the posterior chamber, between the vitreous humour and the uvea, and making what is termed a cataract, may be either within the limit of the capsule of the lens, or between the anterior layer of that capsule and the uvea. The first case is the *genuine;* the second, the *spurious*, cataract.

A genuine cataract, when a primary disease, and unattended from the first with other morbid effects in the eye, is mostly a single independent affection; on the contrary, as the spurious cataract is generally the consequence of internal ophthalmy, it is generally combined with a partial opacity of the anterior layer of the capsule, and, of course, with a genuine cataract.

The first variety of genuine cataract noticed by Beer, is the *lenticular;* it always begins in the centre or nucleus of the lens, mostly presenting a dull yellowish grey colour, which is somewhat deeper at the centre, than at the margin of the pupil; a character retained even when the disease is in its most complete stage. If the lenticular cataract is hard or firm, "the opacity has a greyish appearance, with more or less of the yellowish brown, or amber tint towards the centre. In the firm and darker-coloured portion, it resembles wax slightly softened by heat; the circumference is lighter-coloured and softer, being about the consistence of soft jelly. The more we see of the amber colour, and the deeper the tint, the harder is the cataract; the greyer its appearance, the softer is the consistence." The central portion is firmer than the rest. In a few instances, the lens has been of a dark brown, or mahogany colour, and hard throughout. An ordinary firm cataract presents the consistence of wax. The firm cataract, with the amber tint in the middle, gradually shaded off into grey, is the ordinary form of the complaint in advancing age. (*Lawrence, Op.* cit. p. 399.) It always forms slowly; and except when the iris is too dark-coloured, it is more or less attended with a blackish ring at the edge of the pupil, which ring becomes plainer as the disease advances. It never causes any alteration in the expansion or contraction of the iris; nor does it even in its highest degree deprive the patient of all power of vision, who in shady places, or when the pupil is artificially dilated with hyosciamus or belladonna, is often capable of distinguishing pretty well many objects, which are placed laterally with respect to the eye. A lenticular cataract is usually at some distance from the uvea, so that the extent of the posterior chamber is manifest, while the opacity presents more or less of a convex appearance, and never that of very white cloudy specks. Frequently the lenticular cataract is unattended with any change in the capsule, or the liquor of Morgagni. In most cases of senile cataract, not preceded by inflammation, the capsule is said to remain transparent. (*Travers's Synopsis of the Diseases of the Eye*, p. 207. 8vo. Lond. 1820.)

The second species of genuine cataract, noticed by Beer, is the *capsular*. The disease seldom commences in the centre of the pupil, and usually arises at its margin in the form of distinct, white, shining points, streaks, or specks; its colour, therefore, is always very light, and never altogether uniform, even when the disease is completely formed. The dotted or mottled appearance of this cataract, is also particularly noticed by Mr. Travers. (*Synopsis of the Diseases of the Eye*, p. 207.) The blackish ring, which, when the iris is light-coloured, is even more evident in this than the lenticular cataract, is here not owing to the shadow of the iris, but to its dark border; for this cataract is too near the iris for any shadow to be formed. This observation, however, is somewhat at variance with what Mr. Travers has remarked; for when a transparent circumference can be seen on dilating the pupil with belladonna, he has never found the capsule opaque; and he believes, that the black rim may be considered as the diagnostic mark of the transparency of the capsule. But, when the opacity of the lens is diffused, this sign is of course absent. (*Med. Chir. Trans.* vol. iv. p. 288.) The disease has some effect on the motions of the iris, at least their quickness. A capsular cataract never remains long the only affection, but is followed by disease of the lens itself; a fact, says Beer, which cannot surprise us, when we consider, that it is through the medium of the capsule, that the particles of the lens are incessantly undergoing the changes of removal and reproduction.

The *capsular cataract* is subdivided by Beer into the *anterior*; the *posterior*; and the *capsular cataract*, in which both the front and back portions of the capsule are opaque.

The *anterior capsular cataract*, which is not at all unfrequent, does not continue long in this form after it has attained a high degree; but, according to Beer, becomes combined with an opacity, and, according to Mr. Travers, with a slow absorption of the lens itself. (*Synopsis, &c.* p. 207.) "When the capsule is completely opaque (says Mr. Travers), we can hardly judge of the texture of the lens." But, in such examples, "the lens is commonly diminished in bulk; it undergoes a waste after the opacity of the capsule, so as in process of time to become a membranous cataract. This I conceive to be owing to the obliteration of the vessels of the capsule, from which those of the lens are derived. When the capsular opacity is congenital, it is either purely capsular, or only a very small piece of lens remains. When the capsule turns opaque from injury, the lens is soon greatly reduced in bulk, as appears from the falling in or concavity of the iris, which loses its support, and is demonstrated in the operation. This observation renders the operation with the needle appropriate to the cataract, in which the capsule is opaque, in cases which are not very recent." (*Med. Chir. Trans.* vol. iv. p. 286.) In the anterior capsular cataract, according to Mr. Guthrie, the lens does not generally undergo any diminution, but, for the most part, an enlargement, in consequence of becoming opaque and soft. But he admits, that the reverse is frequently the case in infants, only a small portion of the lens being left, and the rest of the contents of the capsule fluid. (See *Operative Surgery of the Eye*, p. 233.) The anterior capsular cataract may be known by its light grey, and in some places, completely chalk-white colour, intersected by shining mother-of-pearl like streaks and spots. As the capsule is at the same time thicker than natural, the posterior chamber is lessened, and the cataract is not unfrequently close to the uvea, especially when the lens has also completely lost its transparency. In this stage, the movements of the iris are likewise rendered less quick, and the shadow at the margin of the pupil is entirely absent. Hence, vision is not only hurt, but quite impeded, in regard to any correct sensation of light, whether the patient be in a light, or shady situation; and frequently a faint light is completely invisible to him.

The *posterior capsular cataract* belongs to the rarer forms of the disease of the eye; but, says Beer, when it happens, *the lens always participates in the opacity much more quickly, than occurs in the anterior capsular cataract.* Hence, the disease can never be observed up to its perfect development. Respecting the state of the lens, some difference prevails between the statement of Beer and that of Mr. Travers: the latter gentleman informs us, that where the opacity of the posterior capsule is met with, which he agrees with Beer in considering as very rare, *the lens and anterior capsule are usually transparent*; "and when this is not the case, and the cataract escapes with a posterior fold of opaque capsule, it is always accompanied with a considerable discharge of vitreous humour." (*Synopsis of the Diseases of the Eye*, p. 209.) And, in speaking of the opacity of the posterior capsule, in another work, he informs us, that he has not observed, that, in this case, the lens undergoes any diminution. (*Med. Chir. Trans.* vol. iv. p. 286.) Like the anterior capsular cataract, it is denoted by a whitish-grey, unequal, variegated colour; but no light coloured, chalk-white spots and streaks are ever discernible, which, while the lens retains its transparency, may be owing to the distance of the cataract from the pupil. However, the opacity situated behind the pupil, always seems concave, when the eye is inspected, not from before, but from every side of it. While the posterior half of the capsule is not completely opaque, the lens is not materially affected; the eyesight is only more or less weakened; and sometimes, especially with the aid of a magnifying glass, a tolerable degree of vision is enjoyed, notwithstanding the considerable opacity behind the pupil. This species of cataract has not itself any influence over the motions of the iris, and after the lens becomes opaque it is not softened.

Though the *perfect capsular cataract* is not the rarest species of genuine cataract, it cannot be said to be very common. In addition to the symptoms of the anterior capsular cataract, the iris is nearly motionless, the cataract lying close to that organ; the posterior chamber for the same reason is effaced; and an inexperienced surgeon might suppose the anterior portion of the capsule were adherent to the uvea, unless he convinced himself of the contrary by producing an artificial dilatation of the pupil, with hyosciamus or belladonna. Sometimes the iris even seems thrust out by this large cataract, towards the cornea, in a convex form; and the patient can only perceive the strongest kinds of light. Though such is the statement of Beer, I concur with Mr. Guthrie in regarding the above characters, which may attend any large soft cataract as well as the complete capsular one, as by no means a demonstration of the existence of the latter. (*Operative Surgery of the Eye*, p. 235.)

The existence of *perfect capsular cataract* cannot be easily ascertained; for, if the anterior portion of the membrane be opaque, it will prevent us from knowing whether the posterior be so or not. (See *Lawrence on Diseases of the Eye*, p. 494.)

When any portion of the capsule is left behind after operations with the needle, and becomes opaque, the case is termed a *secondary membraneous*, or *capsular cataract*.

The third species of genuine cataract is the *cataracta Morgagniana*, which some term the milk cataract, and others confound with the purulent cataract. It is one of the rarest forms of the disease; so rare, indeed, that it is often regarded as purely hypothetical. (*Synopsis of Diseases of the Eye*, p. 208.; also, *Lawrence, Op.* cit. p. 402.) The following is the form of a disease described by Beer, under this name; it proceeds from a total conversion of the lens into a milky fluid, or thin jelly, frequently attended with a complete capsular cataract. Its origin is said to be always quick, and an immediate effect of chemical injuries of the eye. The following are the symptoms of the case, while it is uncomplicated with disease of the lens and capsule; a state which can never continue long. Though the colour is milk-white, it is delicate and thin, like that of diluted milk. The whole pupil seems cloudy; but whenever the eyeball moves suddenly and violently, or the eyelid is rubbed over the eye, the opaque substances change their shape and position. The posterior chamber is nearly annihilated, which may be owing to the quantity of fluid, or gelatinous substance collected. While the lens and capsule are not materially changed, the sight suffers only a diminution, though it is very cloudy, and small objects cannot be distinguished at all. When, however, the lens and capsule become opaque, vision is quite abolished, a certain power of knowing light from darkness only remaining. Not unfrequently, says Beer, when the lens itself is in a dissolved state, the capsule is partially opaque, the eye is kept quiet for a few minutes, and the patient stands or sits in an upright posture, two rows of opaque matter can be plainly seen; the upper being the least white of the two; the lower presenting a chalky whiteness. However, as soon as the patient suddenly or violently moves his eye or head, or the eyelid is rubbed over the eye, both these rows of opaque matter disappear, and the colour of the opacity behind the pupil again seems uniform.

The fourth species of genuine cataract, described by Beer, is the *capsulo-lenticular cataract*, to which, as it is of large size, he conceives the liquor of Morgagni in an altered state may likewise often contribute. It is by no means uncommon, and attended with the following characteristic symptoms:—The colour of the opacity, close to the uvea, is partly chalk-white, partly like that of mother-of-pearl, and, in many places, both these colours can be evidently seen disposed one over the other, that of mother-of-pearl, however, being always most superficial. Exposure of the eye to the most vivid light scarcely causes any motion of the iris, but the pupil is circular, without any angles in it. After the application of the extract of henbane or belladonna, the iris contracts again exceedingly slowly, and the pupil is long in returning to its former diameter. Besides the obliteration of the posterior chamber, the anterior one itself is mostly diminished, in consequence of the iris being pushed towards the cornea by the very large size of the cataract, and hence the sensation of light is indistinct.

The capsulo-lenticular cataract is not unfrequently the consequence of a slow inflammatory process in the iris, the lens and its capsule; and hence, several varieties of this case, and its not unfrequent combination with a spurious cataract; all which different modifications, says Beer, should be correctly understood previously to an operation, in order to form a just prognosis of its event, and to know what method of operating ought to be adopted.

Of these varieties, the first is the *capsulo-lenticular cataract, conjoined with slight depositions of new matter upon the anterior capsule of the lens*. These after-formations upon the front layers of the capsule, as Beer calls them, put on very different appearances, and accordingly receive various appellations. For instance, the *marbled capsulo-lenticular cataract*, when the chalk-white new-formed substances upon the anterior layer of the capsule are so arranged as to resemble the variegated appearance of marble. The *window* or *lattice capsulo-lenticular cataract*, when the new-deposited substances cross each other, leaving darker-coloured interspaces. The *stellated capsulo-lenticular cataract*, when the new matter runs in concentric streaks towards the middle of the pupil. The *central capsulo-lenticular cataract*, when a single, elevated, white, shining point is formed on the anterior capsule, while the rest of this membrane is tolerably clear, and the lens not completely opaque. The *dotted capsulo-lenticular cataract*, when the front layer of the capsule presents several distinct unconnected depositions on its surface. The *half-cataract*, or *cataracta capsulo-lenticularis dimidiata*, when one half of the front layer of the capsule is covered with a white deposit. In all these, and some othes examples, says Beer, the lens is found to be converted to its very nucleus into a gelatinous, or milky substance.

The second variety of the capsulo-lenticular cataract, pointed out by Beer, is the *encysted*, indicated by its snow-white colour; sometimes lying so close to the uvea, as to push the iris forward towards the cornea; and, at other times, appearing to be at a distance from the uvea. These circumstances, as Beer remarks, almost always depend upon the position of the head; for when this is inclined forwards, the cataract readily assumes a globular form, and projects considerably towards the anterior chamber. Frequently, this variety of the capsulo-lenticular cataract constitutes the kind of case, to which the epithets, *tremulous* or *shaking*, and *swimming* or *floating*, are applied. According to Beer, the reason of such unsteadiness in the cataract is owing to the broken, or very slight connection of the capsule of the lens with the neighbouring textures. The same author had never seen any case of this kind, which had not been preceded by a violent concussion of the eye, or adjacent part of the head. Both layers of the capsule are opaque, and sometimes considerably thickened. The third variety of the capsulo-lenticular cataract, described by Beer, is the *pyramidal*, or *conical*, which is one of the rarer forms of the disease, and always brought on by violent internal inflammation of the eye, especially affecting the lens, its capsule, and the iris. It may be known by a white, almost shining, conical, more or less projecting new-formed substance, which grows from the centre of the anterior layer of the capsule, and is almost in close contact with the pupillary margin of the iris. Hence, the iris is always quite motionless, and the pupil angular. Sometimes this growth from the capsule extends itself so far into the anterior chamber, as nearly to touch the inner surface of the cornea, and sometimes actually to adhere firmly to it; a circumstance, says Beer, which is very constant in the conical staphyloma of the cornea, though not discoverable till the operation is performed. The power of discerning light is feeble and indistinct, and sometimes entirely abolished. Mr. Guthrie regards this case as an advanced degree of the disease described by Beer, under the name of *lymph-cataract:* it ought, indeed, to be classed as a *spurious cataract*. (See *Guthrie's Operative Surgery of the Eye*, p. 246.)

The fourth variety of the capsulo-lenticular cataract is the *siliquose*. Though principally met with in young children, it is not one of the most uncommon affections in adults, and, in the former, it is often falsely regarded as a congenital complaint. When this cataract is extracted either from children, or grown-up persons, Beer says, that the dried shrivelled capsule is always found round the equally dry nucleus of the lens, like a husk, or shell. In children, however, he says, that the nucleus of the lens is often scarcely perceptible, while, in adults, it is always of considerable size; and this may be the reason, why this cataract in children does not present so bright a yellow-white colour, as it does in grown-up persons. In infants, in which it is frequently seen in the first weeks of their existence, it is manifestly produced by a slow and neglected inflammation of the lens and its capsule, arising from too strong light. In adults, the inflammation, exciting this form of cataract, is always owing to external violence; yet Beer supposes, that a considerable diminution of cohesion between the capsule and the adjacent textures must likewise have a principal share in bringing on the disease, which, in grown-up persons, is constantly preceded by a concussion of the eyeball, from the cut of a whip, the lash of a horse's tail, &c. Professor Schmidt had never seen this kind of cataract, except in boys and girls, who in their early childhood had been afflicted with convulsions; and hence, he thought, that the cause of the disease was owing to a partial loosening of the capsule from its natural connections by the violence of the convulsive paroxysms. (*Abhandlung über Nachstaar und Iritis nach Staar-Operationen.* Wien, 1801, 4to.) However, Beer assures us, that he has seen infants, scarcely two months old, affected with this cataract, which had not been preceded or followed by any convulsions; while a much larger number of children with the same kind of cataract had fallen under his notice, where more or less severe blows on the head had been received. With respect to the convulsions, spoken of by Schmidt, he also questions, whether they and the cataract might not be owing to the same cause, viz. the preceding inflammation within the eye. In children, says Beer, this form of cataract may be known by its light-grey, whitish, though seldom very white, colour; its diminutive size, and considerable distance from the uvea; and by the freedom with which the iris moves when no adhesions exist at any points between this organ and the cataract, as occasionally happens; a proof of the previous inflammation of the capsule, lens, and neighbouring textures. The eyesight is never quite impeded, but only much diminished. On the contrary, in adults, this cataract invariably presents a dazzling white hue, and only a few points of it are of a smutty yellowish-white colour, whence the case has been sometimes termed the *gypsum-cataract*. It is not convex, but rather flat; it does not approach the iris; and when free from adhesions to the uvea, which are more likely to happen in adults, it has no effect on the motion of the iris. Vision is generally entirely lost, with the exception of the power of discerning the light, and even this faculty is sometimes destroyed, in consequence of the previous violence done to the eye, whereby not merely the lens and its capsule, but also the retina, have suffered.

According to Beer, one of the rarest varieties of the *capsulo-lenticular cataract* is that *accompanied with a cyst of purulent matter*. It is indicated by a deep lemon colour, very slow motion of the iris, manifest abolition of the posterior chamber, slight convexity of the iris, trivial perception of light, and the weak unhealthy constitution of the patient. This purulent cyst, which sometimes contains a very fetid matter, and was therefore called by Schiferli the *putrid cataract*, (*Theoretisch-Praktische Abhandlung über den Grauen Staar*, 8vo. Jena, and Leipz. 1797.), may sometimes be taken out, without being broken, together with the whole capsule of the lens, with the aid of the forceps, or cataract tenaculum, as was first correctly remarked by Professor Schmidt. In one single example, Beer found the cyst of matter between the lens and the anterior portion of its capsule. Mr. Travers has likewise seen an example of suppuration within the capsule, which projected through the pupil in a globular form, and was filled with pus. The case happened in a lad, and had been preceded by a severe blow on the eye. (*Synopsis of the Diseases of the Eye*, p. 206.)

The sixth, and a rare variety of the capsulo-lenticular cataract, mentioned by Beer, is that described by the French under the name of *cataracte barrée*, the *bar-cataract*, and by Schmidt under the appellation of the *cataract with a girth* or *zone*. The case, says Beer, is one of the least frequent. The diagnosis is easy; for behind the diminished, more or less angular pupil, the cataract can be plainly seen, to which is attached, either in a more or less perpendicular, or horizontal direction, a chalk-white, generally very shining, and thickish kind of bar, or girth, which is closely adherent at both its extremities to the pupillary margin of the uvea, and sometimes reaches, but often only on one side, more or less towards the ciliary processes. The iris is therefore completely motionless, the uvea not being merely adherent to the substance forming what is termed the *bar* or *girth*, but, also, closely connected with the whole front portion of the capsule. The perception of light is either very indistinct, or quite lost, and, not unfrequently, the globe of the eye is somewhat smaller than natural. Beer says, that he has never met with this variety of cataract, except after violent internal inflammation of the eye. He describes the substance, composing the *bar* or *girth*, as being of various consistence, and sometimes firm and almost cartilaginous. In two cataracts of this sort, which he extracted from a boy twelve years of age, he found the *bar*, strictly speaking, ossified, and the capsule, which was nearly cartilaginous, was adherent to a very small firm nucleus of the lens, though they were yet capable of separation. In a dead subject, Beer also examined such a cataract, in which the outer end of the *bar* scarcely extended to the greater ring of the uvea, but the inner end reached over the ciliary processes to the ciliary ligament, from which latter part it was inseparable. (*Lehre von den Augenkr.* b. ii. p. 302.)

Of spurious Cataracts.

The most frequent, according to Beer, is what he names the *lymph-cataract*. It is, without exception, the effect of an inflammation, which is chiefly situated in the iris, the lens, and its capsule. Hence, it is frequently combined with a genuine cataract. The nature of the disease may be known from the patient's account, that the present blindness has been preceded by a painful tedious affection of his eye and head; and from an examination of the eye itself, in which the pupil will be found more or less diminished and angular; the iris either perfectly motionless, or nearly so; the eyesight, and even sometimes the perception of light more, or less impeded, or lost, and this not merely in proportion to the quantity of lymph observable immediately behind the pupil, but also in proportion to other morbid effects produced in the organ of inflammation. Lastly, the surgeon may notice, directly behind the pupil, a plastic lymph, either in the form of a delicate kind of network, or of a thick web of a snow-white colour. Sometimes, in this variety of spurious cataract, though very little coagulating lymph appears upon the anterior portion of the capsule of the lens, and what is effused, as well as the lens itself, is almost clear and transparent, yet the eyesight is considerably impaired, and, on more careful examination of the pupil, something of a dark-brown colour is perceived, which often projects, at several points behind the pupillary edge of the iris, a good way towards the centre of the pupil. In this substance one may discern, with a good magnifying glass, new vessels extending from those of the uvea, and formed by the previous inflammation; by means of which vessels, this mass, and the delicate layer of lymph, are connected with the capsule of the lens. According to Beer's sentiments, it is only the real lymph-cataract which rightly deserves the epithet *membranous*, which is sometimes wrongly applied to the *capsular cataract;* for, says he, *the lymph-cataract alone consists of an adventitious membrane formed by inflammation*, of a web of plastic lymph, which may be very thin and semi-transparent, while the lens and its capsule are nearly quite clear, though the patient may be almost or completely blind, when the effects of the inflammation have extended to the choroids and retina.

The *spurious purulent cataract* is much less frequent than the lymph-cataract. In neglected cases of hypopium (*see this word*), where the pupil is already quite covered with pus, the greater part of the effused matter is sometimes absorbed, and the pupil can be seen again; but, immediately behind it, a quantity of coagulating lymph can be discerned, as in the lymph-cataract, sometimes even projecting partly into the anterior chamber, but blended with particles of purulent matter, so as to give it a light-yellowish tinge, and a clustered appearance. The pupil is always diminished, adherent to the morbid substance, and angular; the motionless iris projects towards the cornea; and not only the eyesight, but even the perception of light, are completely lost, or the latter at least much diminished.

A rare variety of spurious cataract described by Beer, is the *blood-cataract.* Either from some considerable injury of the eye, a large quantity of blood is extravasated in the chambers, and slowly absorbed during the ophthalmy caused by the violence, a part of it, however, remaining in the posterior chamber in the form of small clots, encysted in the lymph which was effused during the inflammation; or else, in the course of a more tedious and neglected case of hypopium, blood is effused in the chambers of the eye, and, not mixing with the pus, still continues in the same form behind the pupil, after the matter has been absorbed. In the first example, this cataract looks like a reddish web, interwoven with silvery streaks or threads; the pupil, though angular, is seldom contracted; the iris nearly or quite motionless; and not only is the light clearly distinguished, but a partial degree of vision sometimes retained. On the contrary, in the second instance, the opacity behind the pupil is very dense, white, studded with reddish or brownish points, or specks, having a clustered appearance, and frequently projecting through the pupil into the anterior chamber; while the pupil itself is very small, and angular, the iris quite incapable of motion, and generally either no perception of light remains, or only a very confined, indeterminate sensation of it. Beer says, that this cataract may easily be mistaken for lymph, and that its difference can only be made out with a good magnifying glass.

The *dendritic cataract* of Schmidt, the *arborescent cataract* of Richter, or the *choroid cataract*, as Beer observes, is not one of the least frequent of the spurious cataracts, and is invariably the consequence of a violent concussion of the globe of the eye, with, or without a wound, whereby a portion of the tapetum of the uvea is loosened; and becomes placed upon the anterior layer of the capsule, more or less resembling in its appearance the arborescent form of the stone termed a dendritis. Immediately after such a concussion of the eyeball, the patient complains of a serious diminution and confusion of vision. Whoever examines the eye only superficially, will certainly not discern the pieces of the tapetum lying upon the yet perfectly transparent capsule of the lens; for the most careful inspection will be necessary for the purpose, and sometimes the aid of a magnifying glass will be requisite. But, as the lens and its capsule are mostly at the same time loosened from their connections, they likewise generally become deprived of their transparency, and, as soon as this has happened, the displaced portion of the tapetum can be readily seen. When inflammation ensues, the flakes of the tapetum become closely adherent to the front layer of the capsule of the lens, and even the pupillary edge of the uvea acquires the same kind of connection, so that the perception of light is diminished. But, says Beer, when inflammation follows, the pupillary margin of the uvea remains free, the iris is perfectly moveable, the light clearly distinguishable, though the lens and its capsule be entirely opaque, and sometimes the flakes of the tapetum, resembling the arborescent *streaks* of the dendritis, alter in shape, size, and position, but never completely disappear, though they may not closely adhere to the capsule. (*Lehre von den Augenkr.* b. ii. p. 303. 309.)

Another classification of cataracts, which is of great importance to an operator, is founded upon their consistence; for this makes not only a great difference in the prognosis, but also in the choice of a method of operating.

When the opaque lens is either more indurated than in the natural state, or retains a tolerable degree of firmness, the case is termed a *firm* or *hard cataract.* When the substance of the lens seems to be converted into a whitish or other kind of fluid lodged in the capsule, the case is denominated a *milky* or *fluid cataract.* When the opaque lens is of a middling consistence, neither hard, nor fluid, but about as consistent as a thick jelly or curds, the case is named a *soft* or *caseous cataract.* When the anterior, or posterior, layer of the crystalline capsule becomes opaque, after the lens itself has been removed from this little membranous sac, by a previous operation, the affection is named a *secondary cataract.*

The harder the cataract is, the thinner and smaller it becomes. In this case, the disease presents either an ash-coloured, a yellow, or a brownish appearance; according to Beer, its colour is very dark. The interspace betwixt the cataract and pupil is considerable. The patient distinctly discerns light from darkness, and when the pupil is dilated, can even plainly perceive large bright objects. In the dilated state of the pupil, a black circle surrounding the lens is very perceptible. The motions of the iris are free and prompt; and the anterior surface of the cataract appears flat, without any degree of convexity. (*Richter's Anfangsgr. der Wundarzn.* b. iii. p. 177.; *Beer,* vol. cit. p. 309.)

Beer says, that it is only the genuine lenticular cataract which can be hard, and it is chiefly met with in thin elderly persons; but, with respect to the opinion, that all cataracts in old persons are firm, he says, this is frequently contradicted by experience. In cataracts, extracted from thin, aged individuals, the lens is sometimes found dwindled, as hard as wood, nearly of a chestnut brown colour, and with its two surfaces as flat as if they had been compressed. This case has sometimes been denominated the *dark-grey cataract,* and is very difficult to make out previously to an operation, being liable to be mistaken for an incipient amaurosis. Hence, in order to judge of it effectually, the pupil should always be dilated with hyosciamus or belladonna.

To the firmish consistent kind, Beer refers several capsulo-lenticular cataracts, namely, the *encysted,* and *conical,* or *pyramidal cataracts,* that to which he applies the epithet *dry siliquose,* the *gypsum-cataract* in particular, and the *bar-cataract,* which at least is always perfectly firm, as well as all the varieties of *spurious cataract.* (*Beer,* b. ii. p. 309.)

The fluid or milky cataract has usually a white appearance, and irregular spots and streaks, different in colour from the rest of the cataract, are often observable on it. These are apt to change their figure and situation when frequent and sudden motions of the eyes occur, or when the eyes are rubbed and pressed; sometimes also these spots and streaks vanish, and then re-appear. The lower portion of the pupil seems more opaque than the upper, probably because the untransparent and heavy parts of the milky fluid sink downward to the bottom of the capsule. The crystalline lens, as it loses its firmness, commonly acquires an augmented size. Hence, the fluid cataract is thick, and the opacity close behind the pupil. Sometimes one can perceive no space between the cataract and margin of the pupil. In advanced cases, this aperture is usually very much dilated, and the iris moves slowly and inertly. This happens because the cataract touches the iris and impedes its action. The fluid cataract is sometimes of such a thickness that it protrudes into the pupil, and presses the iris so much forward, as to make it assume a convex appearance. Patients who have milky cataracts, generally distinguish light from darkness very indistinctly, and sometimes not at all; partly because the cataract, when it is thick, lies so close to the iris, that few or no rays of light can enter between them into the eye; partly, because the fluid cataract always assumes, more or less, a globular form, and therefore has no thin edge through which the rays of light can penetrate. (*Richter's Anfangsgr. der Wundarzn.* b. iii. p. 174, 175.) Mr. Travers believes, that fluid cataracts are rarely contained in a transparent capsule, and his experience has taught him that this membrane is partially opaque, presenting a dotted or mottled surface. The opaque spots are most distinguishable when viewed laterally. (See *Med. Chir. Trans.* vol. iv. p. 284.)

According to Beer, a fluid cataract is mostly conjoined with a complete opacity of the capsule: its diagnosis, therefore, is commonly very difficult, and sometimes its nature cannot be known with certainty, until an operation is undertaken. When the capsule is opaque only in some places, he states, that the following circumstances may be noticed:— The cataract lies close to the uvea, and when the patient inclines his head forwards, the cataract presses the iris towards the cornea, and the anterior chamber becomes evidently smaller; but when he lies upon his back, the cataract recedes in some degree from the uvea. The power of distinguishing the light is unequivocal. When the head is kept quiet for a long time, a thick sediment, and a thinner part, can be plainly remarked in the cataract; during which state, that is, while the two substances are undisturbed, the patient can sometimes distinguish large well-lighted objects, as through a dense mist; but, when the head, or eye, is quickly moved, these two substances become confused together again, and the cataract again presents an uniform white colour. (Vol. cit. p. 312.) It cannot be denied, says Beer, that what is called the *congenital* cataract, and which presents itself in infants soon after birth, when their eyes have been exposed to immoderate light, is not unfrequently fluid; but, in such cases, it must not be presumed, that the lens is always in this state; for, in fact, the cataract is often of that sort which Beer describes under the name of *dry siliquose.*

Sometimes the opaque lens is of a middling consistence, neither hard, nor fluid, but about as consistent as thick jelly, curds, or new cheese. Cases of this description are termed soft or caseous cataracts. The consistence here spoken of may be confined to the two surfaces of the lens, or may exist in its very centre. The first case is the most frequent. The diagnosis is not difficult; for it always has a light grey, greyish white, or sea-green colour. When it is far advanced, it quite impedes the eyesight, and sometimes considerably interferes with the perception of light. (*Beer,* b. ii. p. 310.) As the lens softens in this manner, it commonly grows thicker and larger, even acquiring a much greater size than the fluid. It is not unfrequent to meet with caseous cataracts of twice the ordinary size of a healthy crystalline lens. The motions of the iris are very sluggish. (*Richter's Anfangsgr. der Wundarzn.* b. iii. p. 178.) Indeed, Beer says, that it is sometimes requisite to use the hyosciamus (or rather belladonna) in order to ascertain, that no adhesions exist between the uvea and the cataract, for, in such cases, the posterior chamber is very often completely abolished, as the more caseous the lens is, the larger it is; and hence likewise the black ring at the edge of the pupil is not at all owing to the shadow of the iris, but entirely to the dark border of the iris at the margin of that opening. According to Beer, the colour of such cataracts is never uniform, but more or less speckled; the spots, however, either have no determinate outline, or they seem like mother-of-pearl fragments, into which the cataract crumbles when extracted, or couched, or else they assume the appearance of clouds. (*Beer*, b. ii. p. 311.) According to Mr. Travers, the caseous cataract has a heavy dense appearance, uniformly opaque, a clouded, not a fleecy, whiteness, and sometimes a greenish or dirty white tinge. (*Med. Chir. Trans.* vol. iv. p. 285.) It is observed, that cataracts are never hard in the young, and that a hard lens is never met with below the age of puberty. Cataracts are not always hard in old persons: we may have soft cataracts in the old, and hard ones in the middle period of life. (See *Lawrence, Op.* cit. p. 410.) I lately attended, with Mr. Alexander, and Mr. Bainbridge of Tooting, a young woman eighteen years of age, from whom Mr. Alexander extracted a lens, which was as firm as cartilage. The case was one of congenital cataract.

In estimating the consistence of cataracts, perhaps their size is a better criterion of it than their colour; and, "the larger and more protuberant the lens, pressing forwards into the pupil and against the iris, the greater is the certainty of its being soft." (See *Guthrie's Operative Surgery of the Eye*, p. 209.) Yet, soft cataracts are commonly grey, greyish white, bluish white, or milky, without any mixture of the yellow, or amber colour. (See *Lawrence on Dis. of the Eye*, p. 402.) According to the latter authority, cataracts of a dull green, a yellowish green, a brighter yellow, or a dirty white colour, are the consequences of internal disease of the eye. In simple cataract, the colour of the opacity is grey, yellowish grey, greyish or darkish brown, milky, or chalky white, and sometimes pearly, or silvery. In young persons, the cataract is almost invariably white or grey, or of a milky, or bluish white tint. When a brownish, or yellowish, state of the lens is seen in a young person, it may almost certainly be ascribed to internal disease of the eye. (P. 407.) The investigations of Dr. Mackenzie have taught him, that, "whiteness denotes either a dissolved lens, or a capsular cataract; greyness, a lenticular cataract; amber, or dark grey, that the cataract is hard; light grey, that it is soft. If the whole extent of the pupil is uniformly opaque, the cataract is probably lenticular; if the opacity is streaked or speckled, it is probably capsular. If the opaque streaks radiate from a centre, the posterior hemisphere of the capsule is probably the seat of the disease. If the form of the opacity is convex, the anterior hemisphere of the capsule is the part affected; if concave, the posterior hemisphere. With the light concentrated on the pupil by means of a double convex glass, all these particulars are to be carefully investigated." (*On Dis. of the Eye*, p. 675. ed. 2.)

A cataract, which is recent, and has originated suddenly, especially in young subjects, requires much more circumspection, ere an operation is determined upon, than a cataract, which has already existed a long while, and the formation of which has been only gradual, particularly in an old subject; for the first case is more frequently owing to a concealed slow kind of inflammation than is generally supposed. (*Beer*, vol. cit. p. 314.)

Formerly cataracts were denominated *mature*, and *immature*; terms which, previously to the time of Mr. Pott, who fully exposed their impropriety, often led to the erroneous supposition, that every cataract must acquire an increase of consistence with time, a hardness indicated by a pearly colour, and be thereby rendered more fit to be depressed or extracted. "This opinion (as Mr. Guthrie has observed) founded on the hardness or softness of the cataract, as dependent upon its duration, is contradicted by experience; for cataracts of fifteen or twenty years' duration, and of a pearly colour, have been extracted perfectly soft, whilst others of one year's standing, and of a milky colour, have been found hard. Neither is the relative state of blindness, under these particular circumstances, a more just criterion; patients having been found almost entirely blind with a soft cataract, whilst, through a hard one, they could still distinguish objects and colours." (*Operative Surgery of the Eye*, p. 190.) If, however, the term *mature* be used, as denoting the full development of the cataract, previously to which stage an operation should not be undertaken, the phrase is not destitute of foundation. (See *Lawrence*, *Op.* cit. p. 408.)

Another very useful and practical division of cataracts is into *simple local* and *complicated*. A *simple local* cataract is so denominated by Beer, when the patient is in every other respect perfectly healthy, and no disease prevails in any other part, however distant from the eye. A cataract may be *complicated* in three ways; for it may be attended either with other simultaneous disease in the eye itself, or its appendages, when the case is termed a *local complicated cataract*; or there is some other disease prevailing in the system, either unconnected or connected with the production of the cataract, which then has the epithets *general complicated* applied to it; or, lastly, both descriptions of complication exist together, the *complete complicated cataract*. According to Mr. Guthrie, *idiopathic* or *constitutional cataract* generally affects both eyes; and the *local* or *accidental* form of the disease is more frequently confined to the organ, that has been injured either by external violence, or active inflammation. (*Op.* cit. p. 190.) However, from my being acquainted with several cases, in which a cataract arose in one eye, without any previous injury or inflammation, and continued many years single, — in one case twenty years, — I conclude, that the exceptions to a part of the foregoing statement are by no means unfrequent.

Amongst the *locally complicated* cases is the *adherent cataract*. The preternatural cohesion may be one of the anterior layer of the capsule with the uvea, produced by effused lymph; it may consist in a very firm connection of the posterior layer of the capsule with the membrana hyaloidea; or it may be an unusually close cohesion of the whole of the capsule with the lens; or, says Beer, all the three species of adhesion may exist together. (p. 318.)

The adhesion of the capsule of the lens to the uvea (synechia posterior) is generally obvious enough; for, as, Beer has observed, the pupillary margin of the iris is not completely circular, and is more angular the stronger the light is. The cataract lies close to the uvea, and is very white. The motions of the iris are more or less obstructed, and, when the adhesion is extensive, are quite prevented. The perception of light is indistinct, often very faint, and sometimes entirely lost, for the preternatural adhesion is always the consequence of previous internal ophthalmy, which, besides occasioning opacity of the lens and its capsule, readily produces other serious effects upon the retina, the choroid coat, and vitreous humour, perfectly adequate to account for the loss of sight, and the incapacity of distinguishing the rays of light. When the anterior layer of the capsule is adherent only at a single point to the uvea, the extent of the adhesion may be readily ascertained by artificially dilating the pupil with hyosciamus or belladonna: and the information, thus obtained, will have great weight in the selection of a method of operating. (*Beer*, loco cit.)

Some other local complications of cataract are so obvious, that they cannot fail to be understood; as, for instance, its combination with an adhesion of the iris to the cornea (*synechia anterior*), with closure of the pupil, unattended by any adhesion of the uvea to the anterior capsule of the lens (*synechia posterior*); as in watchmakers, and hysterical or hypochondriacal subjects, the complications with atrophy, hydrophthalmia, cirsophthalmia specks and scars upon the cornea, pterygium, and various forms of ophthalmy.

According to Beer, the combination of cataract with glaucoma is also readily made out by any body who has once seen the case; for the cataract always presents a greenish and sometimes quite a sea-green colour; it is of prodigious size, so as to project through the pupil towards the cornea; the colour of the iris is more or less changed, nearly in the same manner as after iritis; the iris is perfectly motionless; the pupil very much expanded and drawn into angles, for the most part towards the canthi; the lesser circle of the iris is no where visible, because it lies concealed under the far-projecting soft cataract; the light cannot be perceived, though the blinded patient is frequently conscious of false luminous appearances within the eye (*photopsia*); and, lastly, the case is invariably accompanied with more or less of a varicose state of the blood-vessels of the eye. The origin of this sort of cataract is constantly attended with severe obstinate headach.

There are, says Beer, two other local complications, which are much more difficult to learn before an operation. The first is a cataract combined with a dissolution of the vitreous humour (*synchysis*), the diagnosis of which, indeed, when the affection prevails in a considerable degree, is tolerably easy, as the cataract trembles, and the iris always swings backwards and forwards upon the slightest motion of the eyeball; the globe itself is somewhat affected with atrophy; the eye is quite spoiled, and feels flaccid and unresisting; the sclerotica, immediately around the cornea, is bluish as in infants; and the perception of light is uncertain. On the other hand, when the synchysis is not far advanced, the only symptoms are a suspicious softness of the eyeball, and a swinging of the iris, when the eye is suddenly or violently moved.

The other complication of cataract, sometimes very difficult to detect previously to an operation, is amaurosis. When, indeed, the pupil is extraordinarily large, the iris nearly or quite motionless, and the patient cannot distinguish day from night, and, of course, not the least glimmer of light, no great powers of divination are required to predict with certainty, that no operation will restore the eyesight, which is abolished not by the cataract, but by the existing amaurosis. On the other hand, when the motions of the iris are nearly as free as in the natural state, the pupil as small as it usually is in a given degree of light, the patient capable of judging accurately of the strength of the light, and yet the cataract conjoined with amaurosis, which, with the exception of the faculty of perceiving the light, completely impedes vision, it is then only by a careful inquiry into the history of the disease, that certain circumstances, attending the origin of the cataract, and indicating in some measure the prevalence of amaurosis, can be traced. Sometimes, in consequence of one eye being affected with amaurosis, and not with cataract, a reasonable suspicion may be entertained, that the eye with cataract is also amaurotic; yet, says Beer, in such a case, nothing certain can be known before an operation is done.

He considers the general complications of cataract to be as numerous as the diseases of the constitution itself, or as the affections of other organs, besides the eye; but, the most common are scrofula, gout, syphilis, psora, old ulcers of the leg, and an unhealthy constitution.

Causes, Prognosis, &c.

Old age may be regarded as one of the predisposing causes of cataract, inasmuch as the disease is most frequent in advanced life. Of 500 cataract patients, treated by Dr. Fabini, 268 were males, and 232 females. The ages of these individuals were as follows:—

From 1 to 10 years	14
11 to 20	16
21 to 30	18
31 to 40	18
41 to 50	51
51 to 60	102
61 to 70	172
71 and upwards	109
	500

(See *Mackenzie on Dis. of the Eye, p.* 679.; and *Gräfe und Walther's Journ.* vol. xiv. p. 445. Berlin, 1830.) This table may afford a tolerably correct view of the comparative frequency of cataract at different ages.

It was the doctrine of Wenzel, that persons, much exposed to strong fires, and above the age of 40, were more liable to cataracts than other individuals.

Beer assents to the general correctness of the opinion, that old age is conducive to cataracts, since the disease is most frequently observed in old persons. Yet, says he, that age, nay, a very great age, cannot be deemed a regular cause of cataract, is clear from the circumstance of many very old, and even decrepit, individuals being able, with the aid of spectacles, to read the smallest print; and it would seem that other causes, besides old age, are essential to the production of cataracts; as, for instance, immoderate exertion of the eye during youth, particularly in such employments as expose the organ to a strong reflected light. (*Lehre von den Augenkr.* b. ii. p. 325.) And according to the same author, one of the most important, though least noticed, causes promoting the formation of cataract, is allowing a strong light suddenly to enter the eyes of a new-born or very young delicate infant, the consequence of which is, that cataracts form more or less quickly with inflammation of the capsule and lens, or remain for life incomplete, as is the case in the central capsulo-lenticular cataract.

Frequently (says a modern writer) the cataract "proceeds from an hereditary disposition, which has existed for several successive generations; while, in other cases, it attacks several members of the same family, without any disposition of this kind being recognisable in their progenitors. Among others, Janin mentions a whole family of six persons, who laboured under this disease." (*Obs. sur l'Œil*, p. 149.) Richter extracted the cataract from a patient, whose father and grandfather had been affected with the same malady, and in whose son, at that period, it had begun to manifest itself. He adds, that he had seen three children, all born of the same parents, who acquired cataracts at the age of three years. (*On the different Kinds of Cataract*, p. 3.) "During my apprenticeship with the late Mr. Hill, of Barnstaple, I was present, when he operated on two brothers, and a sister, all of whom were adults, and who stated, that three of four others of their family were affected with symptoms not unlike those which they had experienced at the commencement of the complaint. I myself recently operated on two gentlemen advanced in years, who informed me, that they had a brother on his return from India, who was similarly affected." (See *Adams's Pract. Obs. on Ectropium, Artificial Pupil, and Cataract*, p. 101. London, 1812.) Beer speaks of families in which the children all became afflicted with cataracts at a certain age; cases, says he, where an operation, though done by the most skilful practitioner, hardly ever succeeds. (*Lehre von den Augenkr.* b. ii. p. 331.)

The dust of lime is supposed to be conducive to the disease, cataracts being said to be frequent amongst the workmen in lime-pits and kilns. In such cases, I conceive that the cataract has mostly been the result of inflammation.

Wounds of the eye, where the weapon has pierced the capsule and the lens, and especially violent concussions of the fore part of the globe of the eye, though no wound may exist, are in general followed by a cataract, as an immediate consequence. This is the case, says Beer, even when no inflammation arises from the injury, the cataract often occurring in a few hours, and in so considerable a degree as not to admit of being mistaken.

The cause of cataract, thus rapidly produced, must depend, in Beer's opinion, upon the complete separation of the lens from its connections with the capsule, and not unfrequently in part upon the detachment of the capsule itself from the neighbouring textures; for, in such cases, this membrane also gradually becomes opaque.

In the opinion of Delpech, Demours, Wendt, and Walther, the opacity of the lens, termed cataract, is equivalent to its death. That its original structure must be entirely disorganised and destroyed where the cataract is soft, or fluid, must be perfectly manifest. To the view adopted by the preceding writers Mr. Middlemore, inclines. "Parts (says he) may be discoloured, and may still retain their usual degree of vitality, and their proper grade of organisation; for instance, a serous membrane may be rendered opaque, or the colour of the iris may be changed by inflammation, and yet we do not say, that either the one or the other of these textures has lost its vitality, when merely so altered; but I suspect that, when the crystalline lens has become opaque, it ceases to be a living part of the animal machine. The occurrence of cataract in very aged persons, and of congenital cataract, the hereditary predisposition to cataract in some families, and the proneness of the lens to become opaque from slight injury, strongly dispose me to this opinion. If common senile cataract be not caused by death of the lens; if this explanation of its opacity be rejected; we are totally at a loss to explain its frequent occurrence in aged persons. It is evidently not produced in them by inflammation; for it takes place first—it is perceived—in the centre of the lens: it occurs in old feeble persons, and is unattended by pain, or by any morbid effect in the other parts of the eye, which can with propriety be referred to inflammation." (*On Dis. of the Eye*, vol. ii. p. 62.) On this point I should say, that there is evidence rather of disorganisation, or of alteration of texture, or of new deposit in the lens, than of actual death of it. When other textures lose their transparency slowly and insidiously without inflammation, is it usual to refer such change to loss of vitality? On this part of the subject, I consider the observations of Dr. Mackenzie judicious. The most frequent kind of cataract (says he) is that which occurs in old age, independently of inflammation, or injury. We ascribe this variety of cataract to a defective nutrition, gradual decay, or marasmus of the lens. But, in fact, we are unacquainted with the proximate cause of this sort of cataract. It ends not merely in an opacity, but in a peculiar change, which, by some, has been compared to a coagulation, and, by others, to a necrosis, and which is entirely wanting in the glaucomatous state of the lens. The lens also loses its natural adhesion to the internal surface of the capsule, and, in some cases, an effusion of fluid takes place between them.

"Next in point of frequency is cataract from injuries. These rupturing the capsule, will admit the aqueous humour into contact with the lens. Even the smallest puncture of the capsule will induce lenticular cataract. If the rupture of the capsule is considerable, in four and twenty hours, we sometimes see the lens opaque, an effect attributed to the coagulating influence of the aqueous humour, but which is more probably owing to inflammation excited in the lens. Should the rupture of the capsule remain open, the whole lens may dissolve in the aqueous humour, be absorbed, and thus the pupil become clear. In this case, opaque portions of the capsule often remain visible, although, by the dissolution of the lens, a considerable share of vision is restored.

"If the wound of the capsule closes, the dissolution of the lens ceases, the cicatrix of the capsule assumes a chalk-white appearance, and thus a capsulo-lenticular cataract is formed. It has been conjectured, that the capsule is occasionally ruptured in the tetanic state of the eyes, which attends the convulsions of young children, so that the aqueous humour being admitted within the capsule, the lens becomes opaque. In some cases, a blow on the eye, without any penetration of its tunics, ruptures the capsule; while, in others, cataract, generally attended by amaurosis, follows a blow, without any apparent rupture or dislocation.

"Inflammation is in some cases the proximate cause of cataract. Indeed, anterior and posterior capsular cataracts may be compared to specks of the cornea; while, in some instances, the lens also from long continued inflammation, becomes opaque, dissolves into a milk-like fluid, or even suppurates. Ossification of the lens and its capsule is another termination of inflammation of these parts." Iritis is sometimes followed by opacity of the capsule and lens. (See *Mackenzie on Dis. of the Eye*, p. 677.)

Dr. Mackenzie has met with a greater number of stocking-weavers affected with cataract, than of any other trade. The disease in them was often attended with amaurosis. "Looking intensely at an object in motion, which their occupation requires, is probably the cause of their eyes becoming diseased." According to the same authority, the inhabitants of volcanic countries, as Naples and Sicily, are very subject to cataract. (*Op.* cit. p. 679.) Respecting his statement, that wine and spirituous liquors promote its occurrence, I may observe, that the disease does not appear to be particularly frequent among the drunken classes of society in London.

In this country, no faith is put in the notions, respecting the constitutional influence of rheumatism, gout, scrofula, syphilis, &c. in the production of cataracts, except where such general disorders directly excite inflammation of the eye, and opacity of the lens or its capsule is brought on as a consequence of such inflammation. Indeed, Mr. Guthrie maintains, that scrofulous inflammation is rarely propagated to the interior of the eye, and that strumous subjects are not more subject to cataract than other individuals; an opinion in which I perfectly coincide. He also remarks, that there is no evidence of syphilitic patients being particularly liable to cataracts, and this, even when they have suffered severely and frequently. In short, he absolutely denies the power of this and other constitutional diseases to promote the formation of an opacity of the lens and its capsule, unless inflammation of the eye be excited by them. (See *Operative Surgery of the Eye*, p. 191.)

Cataracts are said to have been cured in venereal patients, while under a course of mercury. Probably, however, many such cases might have been mere opacities of the cornea, or, at most, only transient opacities of the capsule, or depositions of lymph in the posterior chamber, the consequence of existing or previous inflammation. Wenzel placed no reliance whatever on the power of any remedies to dissipate a cataract, and, as he had remarked their inefficacy in numerous instances, he felt authorised in declaring, that internal remedies, either of the mercurial or any other kind, are inadequate to the cure of this disorder; and equally so, whether the opacity be in the crystalline lens, or in the capsule, whether incipient or advanced.

Although Ware coincided with Wenzel and Beer, in regard to the uncertainty of all known medicines to dissipate an opacity, either in the lens, or its capsule, or even to prevent the progress of such opacity, when once begun, yet, according to his observations, the powers of nature are often sufficient to accomplish these purposes. The opacities, in particular, which are produced by external violence, he had repeatedly seen dissipated in a short space of time, when no other parts of the eye had been hurt. In such cases, the crystalline lens is generally absorbed, as is proved by the benefit, which is afterwards derived from very convex glasses. In some of these cases, though the crystalline had been dissolved, the greater part of the capsule remained opaque, and the light was transmitted to the retina only through a small aperture, which had become transparent in its centre. Instances are also recorded, in which cataracts, formed without any violence, have been suddenly dissipated in consequence of an accidental blow on the eye. The remedies, which Ware found more effectual than others, were the application to the eye itself of one or two drops of æther, once or twice, in the course of the day, and occasionally rubbing the eye, over the lid, with the point of the finger, first moistened with a weak volatile or mercurial liniment. While Mr. Guthrie admits, that opacities perceptible behind the iris, have been cured under a course of medicine, he considers such events very rare, and to have been accomplished only when the opacity arose from slight depositions in the capsule, the result of simple inflammation, rather than from any affection of the crystalline itself. A haziness of the capsule, caused by the extension of inflammation of the iris to it, he says, may almost always be relieved under the treatment proper for the cure of iritis; but, he does not believe, that an opacity of the lens, distinctly discerned to be such, has ever been removed by medicine. He expresses his decided opinion, that if any lenticular cataracts have really been cured, they were caused by external violence, and disappeared in consequence of their dissolution in the aqueous humour, and the action of the absorbents, the opacity of the lens having been the result of a rupture of its capsule. Ware, who at one time supposed that incipient cataracts might be cured by spirituous applications, and particularly the sulphuric æther, latterly abandoned the opinion; and it would seem from a note in the third edition of his book on the cataract, that the cases he published in the first and second, and as proceeding from an external injury, were of the latter description. (*Operative Surgery of the Eye*, p. 250.) In short, the operation is now regarded as the only means, affording any rational hope of restoring the eyesight of patients afflicted with cataracts. Speaking of genuine cataracts, Mr. Lawrence delivers his belief, that no external nor internal medicines, with which we are at present acquainted, can alter the condition of the opaque lens and capsule. General or local measures may occasionally alleviate particular symptoms, or remove concomitant affections; but they have absolutely no influence on the cataract. (*On Dis. of the Eye*, p. 411.) Another experienced and well-informed writer on this subject joins in the belief, that most of the alleged cures have in all probability, been either instances of mere fibrinous effusions on the surface of the capsule, or else cases of ruptured capsule, in which the removal of the opaque lens has been effected by the solvent power of the aqueous humour; while, on other occasions, it is scarcely to be doubted, that no affection of the lens, or its capsule existed; but, that glaucoma, with incipient amaurosis, was mistaken for cataract, and submitted to certain modes of treatment, which, not unfrequently prove efficacious in restoring to a certain degree the sensibility of the retina. (See *Mackenzie on Dis. of the Eye*, p. 698. ed. 2.) The late Mr.

Ware has been the only practitioner, who has attempted the cure of cataract by local stimulants. M. Gondret employs electricity, galvanism, and ammoniacal collyria; and cauterisation of the forehead either with the actual cautery, or an ointment composed of a highly concentrated solution of ammonia. M. Magendie regards the utility of this practice as depending upon its stimulating the fifth nerve, the influence of which is so essentially concerned in the nutrition of the eye, that, when divided, the cornea becomes opaque, and the humours are transformed into a substance resembling curd. Cataract being often suspected to arise from defective nutrition of the lens, some imperfection of the nerve, it is conceived, may be concerned. Here the question arises, were M. Gondret's cases true, or spurious cataracts? Dr. Mackenzie expresses his suspicion, that most of them were of the latter kind. (*Op.* cit. p. 699.)

Notwithstanding the perfection to which the operation, with all its different modifications, really has been brought, its performance will not always re-establish vision; nay, says Beer, it is frequently counterindicated; and even in favourable cases, the result is exposed to many contingencies.

When the operation is done apparently under favourable circumstances, and its event is unexpectedly very incomplete, or quite unsuccessful, surgeons in vain ascribe the failure to the particular method of operating, which they have hitherto adopted, and uselessly abandon it for another; because none of these methods, including that which is preferred, brought to the highest state of perfection possible, can be applicable to all cataracts. But, says Beer, the reason of the ill success is generally rather owing to the operation not having been indicated, or to a mode of operating, not well calculated for the particular case, having been selected. He ridicules the idea of adhering exclusively to any one plan of operating; and whenever the question was put to him, "What is your plan?" he answered, that his custom was to operate in the manner which appeared to him the best adapted to each particular case about which he was consulted. A surgeon should be able to distinguish, first, the cases of cataract, in which an operation may be done with the best chance of success; secondly, the examples, in which the prognosis is more or less doubtful; and, lastly, the cases, in which there is a great probability, or an absolute certainty, of the operation failing, in which last circumstance the practice is prohibited.

According to Beer, the result of an operation will probably be favourable:—1. When the cataract is a genuine local complaint, perfectly free from every species of complication. 2. When the conformation of the eye and surrounding parts is such, as to allow whatever method of operating may be most advantageous for the particular case, to be done without difficulty. 3. When the patient is intelligent enough to behave himself in a manner, which will not disturb the precision and safety of the requisite proceedings in the operation, or the subsequent treatment. 4. When the operator not only possesses all requisite medical and surgical knowledge in general, but is capable of judging correctly, what method of operating suits the particular case; and when besides he has derived from nature and acquirement such mental and corporeal qualities, as are essential to a skilful operator on the eye; viz. an acute eyesight, a steady, but light, skilful hand, excellently qualified for mechanical artifice in general; long, pliant fingers; a delicate touch; a certain tenderness in the scientific treatment of this particular organ; complete fearlessness; invincible presence of mind; and proper circumspection. 5. When the requisite instruments are not too complicated; but well adapted to the purpose, and in right order. 6. When the domestic condition of the patient is such as not to occasion any particular disadvantages during or after the operation. Yet, says Beer, even with this fortunate combination of circumstances, uniform success must not be expected; for a patient, whose sight is quite prevented by this disease, and who, previously to its origin, was already far-sighted, will be still more so after the removal of the diseased lens, and, in order to see distinctly the most common objects which are near, he will be obliged constantly to employ suitable glasses. An individual of this description, though the operation be done with great success, is apt not to be satisfied. But such patients as were short-sighted previously to the formation of their cataracts, are more pleased with the restoration of vision; as, before the operation, their eyesight was much less than what it is now, and in general they can lay aside the glasses, which they formerly made use of, without having occasion for any others. Lastly, as Beer remarks, although patients, who, before the origin of their cataracts, were neither far nor short-sighted, are sensible of the important benefit of an operation, inasmuch as they now plainly discern all objects again, yet they are usually obliged to employ spectacles in reading, writing, or doing any kind of fine work.

On the other hand, the result of an operation Beer considers always more or less doubtful:—1. When the cataract is only locally complicated, as, for instance, with pterygium, which may not form any absolute reason against the experiment. 2. When the conformation of the eye and surrounding parts causes several hinderances to the operator; as is the case, when the eye is small, and deep in the orbit, and the fissure of the eyelids very narrow. 3. When the patient is either very obstinate, rough-mannered, particularly timid, or, badly fed. 4. When the surgeon knows how to operate only in one way, in which, perhaps, he has also not had sufficient experience, and when possibly he is also deficient in the qualities specified above, as essential to a good operator on the eyes. 5. When the instruments are bad. 6. When, in the patient's domestic affairs, there are any circumstances, which cannot be removed, and are likely to have a bad effect upon the operation, as an unwholesome, damp room, great uncleanliness, &c. 7. When the origin of the cataract was attended with repeated, or tedious headach, though this may have subsided a long while. 8. When the patient is particularly subject to catarrhal and rheumatic complaints, especially affecting the eyes. 9. When the patient has often had, or still labours under, an attack of erysipelas, notwithstanding the parts inflamed be remote from the eye. 10. When the patient's skin is peculiarly irritable. 11. When in his childhood, or youth, he has been frequently afflicted with convulsions, or epileptic fits, though these complaints may have ceased many years. 12. When there is the least tendency to certain constitutional diseases, scrofula, gout, syphilis, &c. Gout, however, does not always make an operation fail, as we learn from Mr. Travers, who, in three cases, extracted the cataract from gouty subjects, and, though a smart attack of the disease followed the operation, the eyes were unaffected and the sight was well recovered. (*Synopsis of the Diseases of the Eye*, p. 297.) 13. When the patient's habit is bad, though not affected with any definite disorder. 14. When the patient in his youth has often been troubled with attacks of ophthalmy. 15. When he cannot perceive the different degrees of light, and correctly describe them, while nothing to account for this state can be detected in the eye itself. 16. The result of an operation is always very doubtful, when there is the slightest tendency to hysteria, or hypochondriasis. 17. When the patient is subject to violent mental emotions, mania, &c. 18. When the eye to be operated upon can still discern things, however feebly; a state, which generally produces an involuntary resistance to the necessary measures in the operation. 19. When the cataract is the consequence of a wound, though free from complication. 20. When the patient is in the state of pregnancy. 21. When one eye has been already destroyed by suppuration. 22. And, lastly, when one eye has already been operated upon without success, by a man whose professional judgment, skill, and caution, are unquestionable.

In almost every case of congenital cataract in a child, under eight years of age, where the capacity to distinguish the different degrees of light is possessed, and where the eye is, in other respects, healthy and perfectly formed, the prognosis, with reference to the probable result of an operation, will be favourable. (*Richard Middlemore on Dis. of the Eye*, vol. ii. p. 68.)

According to Beer, the result of the operation will be more or less unfavourable: —1. When the patient is affected with gutta, or acne rosacea, not the effect of hard drinking, but rather of scurvy. 2. When evident traces of some general disease of the constitution are present. 3. When the patient has been ill, and is only yet convalescent. 4. When any other disease, though not constitutional, is present. 5. When the cataract is adherent for a considerable extent to the uvea, or an incurable, though not very severe chronic inflammatory affection of the eyelids, or eyeball, prevails, as, for instance, an habitual inflammation of the Meibomian glands; ectropium of the lower eyelid; the remains of a pannus; or, a strong aversion to light.

Lastly, as Beer observes, every operation must fail, when the cataract is manifestly joined with complete amaurosis, a dissolution of the vitreous humour, dropsy, or atrophy of the eye, some species of ophthalmy, glaucoma, or a general varicose affection of the blood-vessels of the eye.

The capacity of distinguishing light from darkness, and, in a shady place, where the pupil is not too much contracted, of perceiving bright colours and the shadows of objects, is, as Scarpa has particularly noticed, a very important desideratum in every case, selected for operation.

The power of distinguishing light from darkness is even more satisfactory than motion of the iris. I have met with several cases of complete gutta serena, in both eyes, in which there was the freest contraction and dilatation of the pupils. Had such patients been also afflicted with cataract (a complication by no means unfrequent), and a surgeon, induced by the moveable state of the iris, had undertaken an operation, it must of course have proved unavailing, since the rays of light could only have been transmitted to an insensible retina. Richter and Wenzel make mention of these peculiarities, and the latter refers the phenomenon to the iris deriving its nerves wholly from the lenticular ganglion, while the immediate organ of sight is constituted entirely by another distinct nerve. Hence, motion of the iris is not an infallible criterion, as authors have stated (*Wathen*), that the retina is endued with sensibility. Mr. Lucas attended, in conjunction with Hey and Jones, five children of a clergyman at Leaven, near Beverley, who were all born blind. He writes, "None of them can distinguish light from darkness; and although the pupil is, in common, neither too much dilated nor contracted, and has motions, yet these do not seem to depend upon the usual causes, but are irregular." (*Med. Obs. and Inq.* vol. vi.)

The reciprocal sympathy between the two organs of sight is so active, that no one, solicitous to acquire either physiological or pathological knowledge respecting them, ought, for a moment, to forget it. Hence, in the examination of cataracts, it is of the highest importance to keep one eye entirely secluded from the light, while the surgeon is investigating the state of the iris in the other; for the impression of the rays of light upon one eye, sensible to this stimulus, is known to be often sufficient to produce corresponding motions of the iris in the opposite one, although in the state of perfect amaurosis. It is now well established, that the action of the iris is not exclusively sympathetic with the impression of light upon the retina of the eye, to which it belongs. The action of the iris may depend, indeed, first, upon the direct agency of light upon its irritable and contractile texture; secondly, upon the stimulus of light upon the retina; or, thirdly, upon a sympathy with the iris of the opposite eye. In investigating the state of the retina in several forms of disease, these three influences over the action of the iris should be remembered. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 79.) In other examples of cataract, the pupil may be quite motionless, and yet sight shall be restored after the performance of an operation. (*Wenzel.*) There are two circumstances, however, which may prevent us from ascertaining, whether the retina is sensible to light or not:—The first is, a circular adhesion of the crystalline capsule to the iris: here Richter thought, that some opinion might be formed of the nature of this case, by observing the distance between the cataract and pupil; inferring, that when the space between the pupil and opaque lens was inconsiderable, such an adhesion had happened; and, when the cataract did not seem particularly close to the pupil, and yet the patient could not discern light from darkness, that it was complicated with amaurosis. The second circumstance, sometimes utterly preventing the ingress of any light to the healthy retina, is the round bulky form of the cataract.

But although the power of distinguishing light from darkness is more satisfactory than motion of the iris, it is not an unequivocal test of the retina being perfectly free from disease. While amaurosis is incomplete, the patient can yet distinguish light and the shadows of objects. Dilatation of the pupil is, also, a deceitful criterion of the complication of this disease with the cataract. When the cataract is large, or adherent to the iris, the pupil is frequently much dilated, though the optic nerve may be natural and sound: the pupil often continues quite undilated in a perfect gutta serena. (*Richter.*)

From all this it must be manifest, 1st, That the irregularity and inconstancy of the symptoms of amaurosis, together with the possibility of particular states of the cataract rendering the patient utterly unconscious of the stimulus of light, make it necessary for the surgeon to be particularly attentive to the appearance and to the history of the origin and progress of the disease, in order to understand the real condition of certain causes. 2dly, That, when the patient can distinguish light from darkness, though the iris may be motionless, there is good ground for trying an operation. Possibly, in this circumstance, an incipient *amaurosis* may exist; but the *chance* of the defect of the iris arising from other causes; the *certainty*, that the opaque body *must* be removed from the axis of sight (even if the disease of the retina be cured), ere sight can be restored, and the *improbability* that an operation to cure the cataract will render the other complaint at all less remediable, fully justify the attempt. Frequently, the patient has a fully formed cataract in one eye, which presents the signs of amaurosis, while an incipient cataract, or one as much advanced, exists in the other, which, at present, is free from these symptoms: in this case (says Mr. Travers), the cataract of the latter should be removed, without delay. (*Synopsis, &c.* p. 314.)

The concurrent testimony of almost all writers upon the subject tends to prove, that the restoration of sight has sometimes been effected in the most hopeless cases; and I am, therefore, of opinion with Mr. Lucas that, in all doubtful cases, an operation should be tried as a remedy by no means violent or hazardous. (*Med. Obs. and Inquiries*, vol. vi. p. 257.)

I shall conclude this part of the subject with annexing the sentiment of Mr. Travers, viz. that it would be incorrect to say, that the operation is unadvisable in all cases of cataract, in which the patient has no sense of light; for it is possible, that the density of the lens may be such as absolutely to exclude the light, and that the motions of the iris may be therefore suspended; or from some degree of the pressure of the lens, or adhesion of the uvea to the capsule, that the pupil may be undilated, and the circumference of the lens permanently covered. But, undoubtedly, says Mr. Travers, a case of this description is unpromising. "A strong sense of light, by which at least to know the direction in which it enters the apartment, to be sensible of its falling on the eye, and of a shade, as the hand for example, intercepting it, with a corresponding freedom of motion of the pupil, is the most favourable state for the operation." (*Synopsis of the Diseases of the Eye*, p. 315.)

As it not unfrequently happens that cataracts, produced by external violence, spontaneously disappear, (*Pott, Hey, Ware, &c.*) the operation should never be too hastily recommended for them.

Respecting the question, whether an operation ought to be done, when only one eye is affected with cataract, and the other is sound, some difference of opinion prevails.

One reason assigned by the condemners of this practice, viz. that one eye is sufficient for the necessities of life, is but of a frivolous description; but another, that the patient would never be able to see distinctly after the operation, by reason of the difference of the focus in the eyes, is one of true importance and well deserving investigation. To prove that success does sometimes attend the practice of couching, an extraction, when only one eye is affected with a cataract, I refer to a case reported by Maître-Jan. (*Traité des Maladies de l'Œil*, édit. Paris, 1741. 12mo. *Obs. sur une Cataracte laiteuse*, p. 196.)

Also to Baron Wenzel, who was in the habit of extracting cataracts with some success when only one eye was affected with the disease, as may be learned by referring to the cases here specified. (*Cases* 6. 13. 16. 19. 22. 25. 29. 30. 31. 34. &c. *Treatise on the Cataract.*)

Richter was formerly convinced, that the advice not to operate, when there is a cataract only in one eye, ought, for several reasons, to be disregarded; he reminds us of the wonderful consent between the eyes, so that one is seldom diseased without the other, sooner or later, falling into the same state; and hence he questions, whether it may not be possible to prevent the loss of the sound eye by a timely operation. *An non caveri possit jactura integri oculi tempestive extrahendo cataractam prioris?* (*Obs. Chir.* fascic. 1.) He adverts to the remarkable case related by St. Ives, where a man was wounded in the right eye by a small shot, and, shortly afterwards, had a cataract in it; he then gradually became blind in the left, but soon recovered his sight in it after the cataract had been extracted from the right one. Here let us notice, that St. Ives (*Maladies des Yeux*, chap. xv. art. 3.) makes no mention of any confusion in vision, in consequence of the different refracting powers of the two eyes in question. From some modern publications, indeed, it would appear that, in a few instances, an incipient cataract in one eye has actually disappeared of itself, after the operation had been performed for a complete one in the other. (*Carmichael in Med. and Physical Journ.* vol. xix.; *and Stevenson, in Edin. Med. and Surg. Journ.* No. lxxvii. p. 521.) This is a circumstance which is urged by the latter gentleman, not only as a strong reason for disregarding the common opinion, that a cataract should never be operated upon while the other eye enjoys useful vision, but as a powerful motive for doing the operation even at an early period, so that, if there be no cataract in the other eye, the operation may be the means of preventing its formation, or, if it be already beginning, the chance of its dispersal by the effect of the removal of the other cataract may be taken. In the *Medical and Physical Journ.* for May, 1808, is also an ingenious paper, defending the practice of operating when only one eye is affected. Another reason assigned by Richter, (*Obs. Chirurg.* fascic. 1.) for disregarding the above precept, is, that in waiting until a cataract forms in the other eye, the existing one, which is at this moment, perhaps, in the most favourable state for the operation, may soon change so much for the worse (for instance, it may contract such adhesions to the iris) as either to destroy all prospect of relief, or, at most, afford but a very precarious and discouraging one. The length of time necessary to wait is also uncertain and tedious. I once saw a man in St. Bartholomew's Hospital who had had a cataract in one eye fifteen years, during all which time the other continued quite sound; and another case of twenty years' standing has lately been communicated to me. It is right to state that Richter latterly inculcated a contrary opinion to what he formerly espoused, and observed that the patient not only does not see better with the two eyes after the operation, than with one before it; but he frequently sees more confusedly, because the eye that has been operated on cannot see well without the aid of a glass, which, perhaps, the sound one does not require. (*Anfangsgründe der Wundarzn. Dritter.* b. iii. p. 199.)

Warner's objection is similar to that specified by Richter: he writes, "The eye, from which the crystalline lens is removed, cannot be restored to a degree of perfection at all equal to that of the sound eye, without *the assistance of a convex glass.*" (*Description of the Human Eye, and its Diseases,* p. 85.) But is not the power of using both eyes at the same time, even with the inconvenience of being necessitated to employ a glass for the purpose, preferable to being blind of one? The cases quoted, at all events prove, that confusion in vision is not always the result of the practice: whether the fact is concordant with the modern theory of vision, is entirely another consideration. If it should be found incompatible with it, we must infer, that our knowledge of optics still continues imperfect; not that such well attested examples as some alluded to are unworthy of belief.

For some decided information on the foregoing interesting question, I have referred to Beer; but he seems not to have entered into its consideration at all. The only instance, in which he approaches the subject is, when he notices the custom of covering the eye, which yet possesses more or less vision, when the other alone has a cataract in a fit state for an operation. (*Lehre von den Augenkr.* b. ii. p. 351.)

My experienced friend, Mr. Lawrence, also joins in the belief, that the practice is not productive of advantage.

Mr. Guthrie even declares, that he has met with several "cases in which great inconvenience was sustained from the confusion of vision caused by a successful operation;" and, in one instance, the patient actually wished him to destroy the sight gained by the operation. He therefore joins in the opinion, that the operation should not be attempted on one eye while the other is sound. (*Operative Surgery of the Eye,* p. 258.)

On the same side of the question is Dr. Mackenzie, who remarks that, under these circumstances, delay is the usual practice. "Were it established (says he) that cataract might be produced sympathetically, there could be no doubt of the propriety of removing a single cataract, even when not the slightest appearance of the disease could be detected in the opposite eye; *but* the *fact is* not established. The cataract of old people generally attacks both eyes within the period of a few months; but, in middle life, we often meet with it in one eye, the other having continued unaffected for many years." (*On Dis. of the Eye,* p. 700. ed. 2.)

On the other hand, however, we have the evidence of Dr. Andrew Smith, a gentleman whose observations appear to be deduced from considerable experience in the ophthalmic hospital at Chatham. He admits, that a slight degree of double vision does occur for a short time after the lens has been extracted. In cases where the lens was broken up, however, this casual imperfection did not occur; as, before the lens was absorbed, the eye became accustomed to its privation. "The following (says he) were the remarks I made on the cases, in which extraction was performed:—Three saw objects double when the bandage was first removed, and for nearly twenty-four hours; and then singly. Two saw double for about three hours; and one of them, two days afterwards, upon being surprised, and opening his eyelids suddenly, experienced for a few seconds the same imperfection. A sixth saw constantly double for four days, and after that as distinctly as ever he did; and the other three cases, as above remarked, always single." (*Edin. Med. and Surgical Journ.* No. lxxiv. p. 14.) On the whole, I consider this question, which is a very important one in practice, by no means decidedly settled; and, as far as the evidence of various writers upon it extends, I think those who are in favour of operating upon a cataract, though the other eye is sound, have the best of the argument.

When there is a fully formed cataract in one eye, and vision is retained in the other, Mr. Travers thinks the postponement of the operation wrong. "I am satisfied (says he) that the cataractous eye, if it becomes the subject of an accidental inflammation, is strongly disposed to go into amaurosis; and further, that the retina loses its vigour by the permanent exclusion of light. I speak from repeated observation of the fact. The objection to the operation on the ground of inconvenience, arising from the difference of focus of the two eyes, when one only is the subject of disease, is trivial, and a consideration altogether subordinate; such a defect may always be remedied by glasses properly adjusted. In several cases of amaurosis ensuing upon cataract, I have been disposed to regard the change in consistence and volume of the lens, as productive of a destroying inflammation; in others, of a partial absorption of the vitreous humour." (*Synopsis of Diseases of the Eye,* p. 313.)

On the other hand, Mr. Middlemore contends, that there is no evidence to prove that, when the sight of one eye is destroyed, the opposite organ becomes impaired or amaurotic in consequence. "Persons (says he) who were born with one eye only; persons who, in early life, have had collapse of one eye-ball after an attack of ophthalmia; persons who are affected with congenital or traumatic amaurosis, or cataract of one eye only, very often retain the sight in the opposite organ to a late period of life." (See *Middlemore on Dis. of the Eye,* vol. ii. p. 114.) This author seems to regard an operation for a single cataract as only right on young females, to whom personal appearance is an argument of some weight.

When there are cataracts in both eyes, some authors are of opinion that there is no reason why one should not be operated upon immediately after the other. As, however, the inflammation is likely to be more severe, *cæteris paribus,* when both eyes are operated upon at the same time, Scarpa, who gives the preference to the needle, disapproves of this mode of proceeding, and assures us, that, in patients with cataracts in both eyes, his experience had taught him, that it is better to wait till one eye is well, before any attempt is made upon the other. (*Saggio di Osservazioni, &c.* p. 255.)

On this point the following is Beer's sentiment:— When cataracts are completely formed in both eyes, the patient willing, and every thing promises a favourable result, both eyes may be operated upon at the same time. On the contrary, when any circumstances are present, which render the event of the operation very doubtful, it is most advisable to make the attempt only on one eye, even though the patient absolutely wish more to be done, so that if the first operation should fail, but the complication of this cataract afterwards change considerably to the advantage of the patient, one eye would still be left for a second more favourable attempt. (*Lehre von den Augenkr.* b. ii. p. 350.)

If division of the cataract is the operation to be performed, Dr. Mackenzie approves of operating on both eyes at the same time; if extraction, then he deems it best to await the result of the operation on one eye before touching the other. "Double extraction (says he) decidedly exposes the eyes to greater risk of inflammation." (*On Dis. of the Eye*, p. 700. ed. 2.)

Some years ago it was the common doctrine that no operation should be undertaken for a cataract before the patient had attained the age of docility and reason, and, in a point of view abstractedly surgical, there can be no doubt of the rectitude of such advice; but when it is further considered how essential sight is to the acquirement of education; that youth is the condition best adapted for this indispensable pursuit; that when the child's head is steadily fixed, the needle admits of being employed; that, with the aid of an assistant, this object can most effectually be accomplished; that, when the operation is delayed, the cataract may acquire adhesions; that persons have not only had cataracts successfully depressed or broken at a very early age, but, with the assistance of a *speculum oculi*, have even had them extracted (see *Ware's note*, p. 90. *of Wenzel's Treatise*), which is universally acknowledged to be a far more difficult process; and that the pupil of the eye, in a young subject, is nearly as large as in an adult (*Warner's Description of the Human Eye and its Diseases*, p. 34.); I cannot help thinking, with Mr. Lucas, that, after a child is old enough to bear an operation, the attempt to cure a cataract with the needle *may be proper* at any age. Surgeons do not refuse to operate for the hare lip as early as two years of age, or even earlier; they do not wait for docility and reason in the patient to make him manageable, and sensible of the propriety of submitting quietly to the performance of the operation; they render him tractable by force, and thus they wisely succeed in making, perhaps with more certainty than reliance upon the fortitude of any human being would afford, a very precise incision, such as the nature of the operation demands: and why should they refuse to attempt the cure of cataracts in children, when the motives are more urgent, and it is equally in the power of art to substitute means quite as effectual as docility and reason in surgical patients? What experienced operator would trust to these qualities, when he undertakes any grand operation, even on the most rational and firm adult? (*Critical Reflections on the Cataract*, 1805.)

The propriety of operating on the cataracts of children seems now firmly fixed on the basis of experience. The needle may be successfully employed on children of the most tender age. The late Mr. Saunders, surgeon to the London Infirmary for Diseases of the Eye, had the principal share in promoting the adoption of this important improvement. His practice confirmed what reason had long ago made probable; and the judgment, tenderness, and skill with which he operated on the eyes of infants, as well as those of adults, were followed by a degree of success which had never been previously witnessed, and which infused quite a new spirit into this most interesting branch of surgery. Subjects from eighteen months to four years old, received most benefit from Mr. Saunders's operations; and, if any intermediate time be selected, Dr. Farre is inclined to recommend the age of two years. "The parts have then attained a degree of resistance which enables the surgeon to operate with greater precision than at an earlier period; yet, the capsule has not become so tough and flexible as it does at a later period, after the lens has been more completely absorbed.

"But this is not the greatest, although a considerable advantage of an early operation; for, in cases in which the patient has no perception of external objects, the muscles acquire such an inveterate habit of rolling the eye, that, for a very long time after the pupil has been cleared by an operation, no voluntary effort can control this irregular motion, nor direct the eye to objects with sufficient precision for the purpose of distinct and useful vision. The retina, too, by a law common to all the structures of an animal body, for want of being exercised, fades in power. Its sensibility, in many of the cases, cured at the ages of four years, and under, could not be surpassed in children who had enjoyed vision from birth; but, at eight years, or even earlier, the sense was evidently less active; at twelve, it was still more dull; and from the age of fifteen and upwards it was generally very imperfect, and sometimes the mere perception of light remained. But these observations do not apply to those congenital cataracts in which only the centre of the lens and capsule is opaque, the circumference being transparent; for, in those, the retina is exercised by a perception, although an imperfect one, of external objects, the motions of the muscles which direct the globe are associated, and an absorption of the lens does not take place: therefore in this variety of the disease, the argument in favour of an early operation, is not so much a medical as a moral one — it is preferable for the purposes of education and enjoyment." (*Saunders on Diseases of the Eye*, p. 153. 155.)

Besides Mr. Saunders, several other surgeons of the present day have become zealous advocates for operating upon the cataracts of children. Even Mr. Ware, before his death, strongly recommended the use of the needle in the congenital cataract of infants and children. The late Mr. Gibson of Manchester likewise urged the propriety of couching young subjects, and fixed on the age of six months as preferable to that of two years. "Whatever objections (says he) have been urged against the safe and effectual use of the couching-needle in infants, have always appeared to me so slight, and so easily surmountable, that, without inquiring particularly into the real state of the question, I have long concluded that the same motives which would induce an operator to couch a cataract at any period of adult life, would equally lead him to perform that operation at any earlier period, when a cataract existed. Acting upon this presumption, *I have operated upon children of all ages for ten years past.*" (See *Edin. Med. and Surg. Journal*, vol. vii. p. 394.)

Mr. Gibson's paper being dated June, 1811, we are of course given to understand that he pursued this practice from the year 1801; he says, "If an operator cannot depend upon his management of the eye, so as to render it steady by the introduction of the couching-needle, he can avail himself of the assistance of a speculum to restrain its motions.

"The following observations will apply principally to infants under twenty months old:—The advantages which an operator possesses in operating upon a child of this age, as compared with a child of three years old or upwards, are important. An infant is not conscious of the operation intended: it is free from the fears created by imagination, and can oppose very feeble resistance to the means employed to secure it with steadiness. At an early age it has not acquired the power of retracting the eye deep in the socket, so that the operator has always a good prospect of introducing the couching-needle with ease, by watching a proper opportunity. The eye has not, at this time, acquired the unsteady rolling motion which, after a few years, is so common and remarkable in children born blind, or reduced to that state soon after birth. So that this impediment to the easy introduction of the needle does not exist in infants a few months old. The operator also has it in his power to administer a dose of opium, sufficient to render the steps necessary to expose the eye, almost entirely disregarded by his patient. With respect to the state of the eye itself, but, particularly that of the cataract, this is more favourable for the operation, than at any future period of life. *In infants, the cataract is generally fluid*, and merely requires the free rupture of its containing capsule, which is in that case generally opaque. The capsule, however, is tender, and easily removed by the needle, so as to leave an aperture sufficiently large for the admission of light. The milky fluid which escapes from the capsule is soon removed by absorption. If, on the other hand (says Mr. Gibson), the cataract should be soft, it is generally of so pulpy a softness, that the free laceration of the anterior part of its capsule, and the consequent admission of the aqueous humour, ensure its speedy dissolution and disappearance, without the necessity of a second operation. Should the cataract happen to be hard, there will be no more difficulty in depressing it, than in an adult.

"The advantages which an operator will possess when he attempts the removal of a cataract in a child of a few months old, are peculiar to that period. In proportion as the age of the patient advances, until he arrives at the age of discretion, and can estimate, in some measure, the value of sight, by feeling its loss, the difficulties opposed to the use of the couching-needle increase. His fears of the operation, the unsteadiness of the eye, and his power of retracting it within the orbit, present considerable, but not insuperable, obstacles; such, however, as every surgeon would willingly dispense with, if he had it in his power.

"Before an operation, at an early age, is recommended, the practitioner ought (as at any other age) to ascertain, that the cataract is not complicated with a defective state of the retina, or with a complete amaurosis. Such cases are by no means uncommon. Some years ago, I recollect to have seen five or six children, the families of two sisters, who were all totally blind, and in an idiotic state, with cataracts accompanied by amaurosis." (*Gibson, Op.* et loco cit.)

I find also in this paper some arguments which are repeated in Mr. Saunders's work:—"Few practitioners at all conversant with cases of blindness from birth, will deny that it is highly probable that the eye may lose a considerable part of its original powers, from the mere circumstance of its having so long remained a passive organ. Hence, probably, it happens, that, in some cases of congenital cataract, the only benefit conferred on the patient by an operation, is that of enabling him to find his way in an awkward manner, and to discriminate the more vivid colours. Such patients have never been able to discern small objects, or to judge, in any useful degree, of figure or magnitude: I am well aware, however," says Mr. Gibson, "that, in some rare instances, such a defective state of the eye exists from birth.

"Another circumstance, which must have attracted the attention of oculists, is, that, in a few years, the eye of a patient born blind acquires a restless and rolling motion, which is at length so firmly established by habit, that he has little control over it. This motion unfortunately continues, for a considerable time, after sight has been restored to such a person, and is a very material obstacle to the early attainment of a knowledge of the objects of vision. He cannot fix his eye steadily upon one point for a moment, and the inconvenience which arises from this unsteadiness, is, to such a person occasionally as great a bar to the distinct view of an object, as the unsteady motion of the same object would be to one whose vision is perfect. This inconvenience any one can appreciate, and, as far as I know, it is completely avoided by restoring sight at an early age." As a motive for operating on infants, Mr. Gibson also comments on the loss of those years which ought to be spent in education. (See *Edin. Med. and Surgical Journal*, vol. vii. p. 394, 400.)

With reference to the results of Saunders's operations, Dr. Farre, informs us, that the sensibility of the eye, "in many of the cases cured at the ages of four years and under, could not be surpassed in children who had enjoyed vision from birth; but, at eight years, or even earlier, the sense was evidently less active; at twelve, it was still more dull; and, from the age of fifteen and upwards, it was generally very imperfect, and sometimes the mere perception of light remained." (See *Saunders on Dis. of the Eye*, p. 154.) In a case which I lately attended with Mr. Alexander, and Mr. Bainbridge of Tooting, the latter fact was unfortunately exemplified after extraction of the lens. The patient was a young woman, aged eighteen, who had congenital cataracts. Dr. Mackenzie is also an advocate for operating in infancy, if possible, before teething commences. (*On Dis. of the Eye*, ed. 2. p. 702.) Mr. Lawrence has operated, with perfect success, on infants of six weeks, but considers the age of two months as generally early enough. He has always operated in the first year, where he has had the choice. (*On Dis. of the Eye*, p. 51.)

Mr. Guthrie considers the period of dentition an unseasonable one for the operation; but excepting the time of this process, if the child be healthy, he thinks it qualified for the attempt at any age, reckoning from that of six months: and that, "even if the operation be delayed until the end of the third or fourth year, little or no inconvenience is found to arise from it." (*Operative Surgery of the Eye*, p. 362.)

When once it is decided to operate upon a cataract, the sooner the operation is done, in general, the better; because the anxiety of the patient increases, every day, nay, every hour. When the operation is deferred for a few days, the greatest caution must be used not to let him expose himself to any causes likely to bring on catarrhal or rheumatic complaints. (*Beer*, b. ii. p. 344.) The following advice, delivered by Mr. Lawrence, with respect to preparation of the patient for operation, seems judicious:—After recommending the operation not to be performed if the tongue is foul, he observes, "No fermented liquors, and generally no animal food should be taken for a week, or fortnight previously; and the bowels should be evacuated by some mild aperient, every other day during this time: they should also be well cleared on the morning of the operation. These remarks will apply to all cases; and generally speaking this is the only preparation necessary. Some patients, however, require other preparatory measures; in plethoric subjects, and such as manifest great determination of blood to the head, direct depletion is necessary. In robust persons, in those about the middle period of life, it will be necessary to resort to venesection; and, if the pulse were full, and the patient young and strong, it might be advisable to take blood freely and repeatedly before operating. In general, it is sufficient to take some blood on the morning of the operation. In those of a plethoric habit, with symptoms of determination to the head, we must practise active depletion; and this is occasionally necessary, even in old persons." (*Lawrence on Dis. of the Eye*, p. 415.) If the bowels are disordered, tongue foul, and appetite lost, a dose of calomel, every second, or third night, followed by salts and senna next morning, ought to be given, three, or four times. "Even if the patient appears to be in perfect health, three or four saline purges ought to be administered at proper intervals, and a strict antiphlogistic plan of diet followed, for at least eight or ten days." (*Mackenzie, Op.* cit. p. 701.)

Mr. Middlemore states, that he has repeatedly operated for cataracts upon very gouty persons, with almost uniform success. His plan is to place an issue in the arm, about a week prior to the operation, to select proper weather for the operation, and to take care that no fit of gout is expected to occur about the time of its performance. In this particular case, he also prefers operating upon both eyes at the same period. (*On Dis. of the Eye*, vol. ii. p. 120.) If a fit of gout is impending, or is supposed to be likely to occur, it should be allowed to pass over before the operation is performed. Or, if the patient has a strong determination of blood to the head, he should be cupped, a few days before the operation is attempted, in addition to the bleeding recommended by Mr. Guthrie on the evening preceding the operation. (*On the Certainty of Extraction*, p. 71.)

OF THE VARIOUS OPERATIONS FOR CATARACT.

Four different operations are practised for the cure of cataracts, viz. one termed *couching*, or *depression*, of which the method called, *reclination*, is a modification: second, named *extraction*: a third, in which the lens is neither extracted nor depressed, but after the needle has been introduced into the eye in the same manner as for depression, the lens is disturbed, or divided, and left in its place to be removed by absorption. This method is frequently termed the operation by *solution*, or *absorption*, which, however, is not altogether an unobjectionable phrase, because these processes are also concerned as a means of restoring vision after keratonyxis: and a fourth, denominated *keratonyxis*, which consists in puncturing the cornea with a needle, the point of which is to be conveyed through the pupil, so as to reach the cataract, which is to be gently broken into fragments. In particular cases, as Beer observes, each of these modes has manifest advantages over the others; but no single method will ever be exclusively preferred by any man of experience and judgment. In every operation for a cataract, the position of the patient, assistants, and surgeon, is of great importance. In order to enable the assistant, who stands behind the patient, to be conveniently near the head of the latter, Beer prefers letting the patient sit on a stool which has no back. However, some surgeons have been in favour of employing a chair, which is completely perpendicular. When the left eye is to be operated upon, the same assistant is to apply his right hand under the patient's chin, and press the head of the latter against his breast, at the same time that he inclines it and himself more or less forward towards the operator, who sits upon rather a high stool, in front of the patient. In this country, a music-stool is commonly preferred, the height of which can be regulated in a moment, by simply turning the seat round to the right, or left, whereby the screw, with which it is connected, is made to rise, or descend, as may be found most desirable. The same assistant then places his left hand flat upon the left side of the patient's forehead, with the points of the fore and middle fingers somewhat under the edge of the upper eyelid; and, with the forefinger, he is now to raise the edge of this eyelid as much as possible, following that finger immediately with the middle one, so as to fix the eyelid with greater certainty. The ends of these fingers, however, must be so applied, as not to touch the globe of the eye in the slightest manner, much less make any pressure upon it; yet so that the upper part of the eyeball and cornea may be gently resisted by them, when the eye rolls upwards away from the instrument about to be introduced, whereby this position, which is extremely inconvenient to the operator, may be immediately rectified. The patient should also sit opposite a clear window, so that a sufficient light may fall obliquely upon the eyes, without any rays being reflected to the cornea, and becoming a hindrance to the operator. Nor should light from any other quarter be ever allowed to fall upon the eyes. The surgeon should sit in front of the patient, whose head ought to be directly opposite the operator's breast, whereby the latter will be enabled to see from above, with the greatest correctness, every thing in the eye during the operation, and will not be under the necessity of raising his arms too considerably. Supposing it to be the left eye, which is to be operated upon, he next effectually draws down the lower eyelid with the left forefinger, the end of which must be placed over the edge of the eyelid towards the globe of the eye. The middle finger is then to be applied in a similar way over the caruncula lachrymalis. The operator now takes in his right hand the requisite instrument for the operation, viz. the needle or knife, which is to be held, like a pen, between the thumb and the fore and middle fingers. By this particular arrangement of the fingers of the assistant and operator, which, indeed, is partly ineffectual where the fissure of the eyelids is very narrow, and the eyeball is diminutive and sunk in the orbit, the restless eye of the timid patient is fixed; for a point of the finger is disposed on every side, to which the eye can possibly turn away from the instrument about to be introduced, and when the cornea is gently touched with the extremity of the finger, the wrong position which the eye is about to take, is immediately prevented. This method of fixing the eye, says Beer, is not merely indispensable for young operators, but is the only perfectly unobjectionable one, which can be employed on this delicate organ, since all mechanical inventions for this purpose, like the speculum oculi, which keeps the eye steady, by considerable pressure, or other contrivances, like Rumpelt's instrument, which does the same thing by means of a short pointed instrument attached to a kind of thimble, and with which the sclerotica is pierced and held motionless, are found to be worse than useless. The only specula, now ever employed, are those of Pellier and Adams. The first is a bent silver wire; the latter, a thick piece of silver, with a concave edge. They are also merely used for fixing the upper eyelid, without making any kind of pressure on the eye itself. In certain cases, where the muscles of the eye and eyelids are affected with spasm, or the eye diminutive, and sunk in the orbit, these instruments prove serviceable. In young subjects, they materially facilitate the operation.

Mr. Alexander, whose great skill in operations on the eye is universally acknowledged, employs no assistant for raising the upper eyelid, or fixing the eye, which objects he accomplishes himself; and, in Germany, this independent mode of proceeding has been particularly commended by Barth. (*Etwas über die Ausziehung des grauen Staare, für den geübten Operateur.* 8vo., Wien, 1797.) Mr. Alexander, however, mostly divides the upper segment of the cornea.

Richter recommends the chair, on which the patient sits to have a high back, against which the head can be firmly supported, and which ought to be perpendicular, in order that the head may not be too distant from the surgeon's breast. (See *Anfangsgr. der Wundarzn*, b. iii. p. 207.)

The plan of supporting the patient's head rather upon the back of the chair, on which he sits, than upon an assistant's breast, was also preferred by Bischoff; because the least motion of the assistant, even that necessarily occasioned by respiration, cannot fail to be disadvantageous.

Of Couching, or Depression of the Cataract, and Reclination.

The operation of couching was once supposed to consist altogether in removing the opaque lens out of the axis of vision, by means of a needle constructed for the purpose; but it is well known to be frequently effectual on another principle, even when the nature and consistence of the cataract do not admit of the depression of the opaque body. Experience fully proves, that the diseased lens, when broken and disturbed with the needle, and especially when freely exposed to the contact of the aqueous humor by a proper laceration of its capsule, is gradually dissolved and removed by the action of the absorbents.

Indeed, couching now means a variety of operations; for, it comprehends not merely the *depression* of the cataract, not simply its *displacement* in any direction whatsoever, not only the *breaking of it piecemeal*, and the *pushing of the fragments into the aqueous humor*; but likewise the *mere disturbance of the opaque body*, whereby its absorption is sometimes effected, without any kind of depression, or displacement of it at all with the needle. When, therefore, the merits of couching are investigated, it is necessary to define precisely what modification of it is meant, and for what particular kind of case its application is designed; for, no surgeon of the present day would confine himself exclusively to one method of operating; and as Mr. Guthrie has remarked, "In considering the advantages, or disadvantages, from any or all of the different operations for cataract, it is absolutely necessary to recollect, that no individual operation is applicable to every species of the disease; that each kind requires an operation for its relief or cure, sometimes of a particular nature, and differing essentially from that which is found most advantageous in another. To collect then all the objections, which can be urged against any of the operations, from a consideration of every case of cataract, to which it is and is not applicable, is merely to confuse the subject, and has generally been done for the purpose of recommending some particular mode of proceeding, rather than to regulate these operations, by the general principles of surgery." (*Operative Surgery of the Eye*, p. 365.) In this respect, the doctrines of Pott, Callisen, Hey, Scarpa, and Dupuytren, are undoubtedly wrong, though their sentiments are blended with many valuable and important truths. Beer, who is by no means a great advocate for depression, admits its utility in particular cases. It is easily comprehensible, says he, that, in this way, a firm and large cataract either cannot be removed without injuring the retina, and the attachment of the corpus ciliare to the vitreous humor, or not far enough to prevent the opaque body from rising again at the first opportunity. Hence, the former complaint about the frequent return of the cataract, and other ill consequences, unappeasable vomiting, suddenly produced amaurosis, and severe inflammation, &c. But, while Beer acknowledges the frequency of these ill effects of depression, he condemns the universal rejection of it, attempted at the present day, and the unlimited substitution for it of *reclination*, which consists in applying the needle in a certain manner to the anterior surface of the cataract, and depressing the opaque body into the vitreous humor, in such a way that the front surface of the cataract is now the upper one, its back surface the lower one, its upper edge backwards, and its lower edge forwards; a change, which Beer says, cannot be made without an extensive destruction of the cells of the vitreous humor. Hence, with few exceptions, this author thinks the common mode of depression should be preferred. (*Lehre von den Augenkr.* b. ii. p. 352.) And, in this sentiment, he is joined by Mr. Travers, who remarks, that the real objection to couching is the breaking up of the fine texture of the globe of the eye, by the forcible depression of the lens. "Whether it be depressed edgeways or breadthways, makes no difference in the result; it must still occupy a breach in the cells of the vitreous humor, and must derange and disorder that delicate texture, and those connected with it. A slow insidious inflammation, marked by a gradual development of the symptoms of disgorganization, viz. congestion of vessels, turbid humors, flaccid tunics, and palsied iris, is too often the consequence. The sight, instead of improving, when the immediate effects of the injury are passed away, remains habitually weak and dim, or declines and fades altogether. The advocates for *reclination* seem to forget, that the principle, which is the same in both operations, is the real ground of objection. As to the position of the lens, I suspect less mischief is done by the old method of depression, as less force is required to break a space for the vertical, than the horizontal lens, provided the depression be carried to no greater extent, than is necessary to clear the inferior border of the pupil." (*Synopsis of the Diseases of the Eye*, p. 318.)

The cases, suited to depression and reclination, seem to Mr. Middlemore to be those, in which the lens is firm and not particularly large, and where, for various reasons, we cannot with propriety perform, or are unwilling to perform, the operation of extraction. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 157.)

The form of couching-needles should vary according to the object designed to be effected in the operation. The needle, used by the late Mr. Hey, that recommended by Scarpa, and another employed by Beer, are the principal ones.

The length of Mr. Hey's needle is somewhat less than an inch. It is round, except near the point, where it is made flat by grinding two opposite sides. The flat part is ground gradually thinner to the extremity of the needle, which is semicircular, and ought to be made as sharp as a lancet. The flat part extends in length, about an eighth of an inch, and its sides are parallel. From the part where the needle ceases to be flat, its diameter gradually increases towards the handle. The flat part is one-fortieth of an inch in diameter. The part which is nearest the handle, is one-twentieth of an inch. The handle, which is three inches and a half in length, is made of light wood, stained black. It is octagonal, and has a little ivory inlaid in the two sides which correspond with the edges of the needle.

Mr. Hey asserts, that his needle will pass through the sclerotic coat with ease; depress a firm cataract readily, and break down the texture of one that is soft. "If the operator finds it of use to bring the point of the needle into the anterior chamber of the eye (which is often the case), he may do this with the greatest safety, for the edges of the needle will not wound the iris. In short, if the operator, in the use of this needle, does but attend properly to the motion of its point, he will do no avoidable injury to the eye, and this caution becomes the less embarrassing, as the point does not project beyond that part of the needle by which the depression is made, the extreme part of the needle being used for this purpose." (See *Hey's Pract. Obs. in Surgery.*)

Scarpa employed a very slender needle, possessing sufficient firmness to enter the eye without hazard of breaking, and having a point which is slightly curved. The curved extremity of the needle is flat upon its dorsum, or convexity; sharp at its edges; and has a concavity constructed with two oblique surfaces forming in the middle a gentle eminence that is continued along to the very point of the instrument; there is a mark on that side of the handle which corresponds to the convexity of the point. The surgeons of the Leeds Infirmary have had one advantage in the needle, which they have used in imitation of Baron Hilmer; I mean, having it made of no greater length than the purposes of the operation demand. A couching-needle is sufficiently long when it does not exceed, at most, an inch in length; this affords the operator a greater command over the motions of the point, and enables him to judge more accurately, how far it has penetrated the globe of the eye, before he has an opportunity of seeing it through the pupil. When Scarpa's needle is preferred, it should therefore be of no greater length than the operation requires. The needle, here described, will penetrate the sclerotic coat as readily as any straight one of the same diameter, and by reason of its slenderness, will impair the internal structure of the eye less in its movements, than common couching-needles. When cautiously pushed in a transverse direction, till its point has reached the upper part of the opaque lens, it becomes situated with its convexity towards the iris, and its point in the opposite direction; and, upon the least pressure being made with its convex surface, it removes the cataract a little downward, by which a space is afforded at the upper part of the pupil between the cataract and ciliary processes, through which the instrument may be safely conveyed in front of the opaque body and its capsule, which it is prudent to lacerate in the operation. In cases of caseous, milky, and membranous cataracts, the soft pulp of the crystalline may be most readily divided and broken piecemeal by the edges of its curved extremity; and the front layer of the capsule lacerated into numerous membranous flakes which, by turning the point of the instrument towards the pupil, may be as easily pushed through this aperture into the anterior chamber, where Scarpa finds absorption takes place more quickly, than behind the pupil.

Beer, and many other skilful operators, give the preference to a straight spear-pointed or lance-shaped needle, with cutting edges. Mr. Middlemore prefers this construction, but with the point slightly curved, the neck round, and the surface broad enough to act upon the lens in depression, or reclination. (See *Middlemore on Diseases of the Eye*, vol. ii. p. 158.) Scarpa's needle, made quite straight, is an eligible instrument; and Beer's small spear-pointed needle, which is sold at almost every shop for surgical instruments, deserves all the reputation which it possesses.

As Mr. Travers has observed, in all cases of operation with the needle, the employment of a solution of the extract of belladonna in an equal part of distilled water, is a point of the first importance. "The space, included between the eyebrow and lash, should be thickly painted with the solution once, or oftener, in the twenty-four hours, and this varnish should be preserved moist for a period of half an hour, in order to admit of its absorption. The frequency of the application must be determined by its effect upon the pupil. The preternatural dilatation should not be permanently maintained; for, if it be, the pupil will in all probability be misshapen," after the use of the belladonna has been suspended, and the iris recovered its power. (*Synopsis of the Diseases of the Eye*, p. 322.)

Many operators apply the moistened extract of belladonna to the eyebrow on the evening before, and on the morning of the operation; and, if necessary, also a solution of it to the surface of the eye. (See *Middlemore*, vol. ii. p. 159.) The upper eyelid is to be raised and held steady against the superciliary ridge by means of the index and middle fingers of the assistant, who stands behind the patient and supports his head, while the operator draws down the lower eyelid himself with the fore and middle fingers of the hand, not engaged with the needle. Supposing the eye about to be operated upon, is the left, the surgeon's fingers, employed for depressing the lower lid, should project a little beyond the margin of the tarsus; the index finger being situated, towards the external canthus, and the middle one towards the caruncula lachrymalis, so that the movements of the eyeball upwards and inwards may be controlled.

The couching-needle (if the curved one be used) is to be held with its convexity forward, its point backward, and its handle parallel to the patient's temple. The surgeon, having directed the patient to turn the eye towards the nose, is to introduce the instrument boldly through the sclerotic coat, at the distance of at least one line and a half from the margin of the cornea, for fear of injuring the ciliary processes. Most authors advise the puncture to be made at about one line, and some even at the minute distance of 1-16th of an inch (*Hey*) from the union of the cornea with the sclerotica; but as the ciliary processes ought invariably to be avoided, the propriety of puncturing the globe of the eye, one line and half, or two, from the margin of the cornea, as advised by Petit, Platner, Bertrandi, Beer, &c. is probably the best practice. However, Mr. Middlemore prefers one line from the cornea, in order to avoid the ciliary processes, and not a greater distance, lest he should wound the retina. (*On Dis. of the Eye*, vol. ii. p. 162.)

Nor is it a matter of indifference, at what height the needle is introduced, if it be desirable to avoid, as much as possible, effusion of blood in the operation. Anatomy reveals to us, that the long ciliary artery pursues its course to the iris, along the middle of the external convexity of the eyeball, between the sclerotic and choroid coats; and hence, in order to avoid this vessel, it is prudent to introduce the instrument one line below the transverse diameter of the pupil, as Dudell, Guntz, Bertrandi, Beer, Scarpa, &c. have directed. If the couching-needle were introduced higher than the track of the long ciliary artery, it would be inconvenient for the depression of the cataract.

The exact place, where the point of the needle should next be guided, is, no doubt, between the cataract and ciliary processes, in front of the opaque lens, and its capsule; but as I conceive the attempt to hit this delicate invisible mark borders upon impossibility, and, perhaps, in the common manner of bringing the needle from the posterior chamber to the upper edge of the lens, is never effected without injuring those processes, as Mr. Guthrie positively asserts (*Operative Surgery of the Eye*, p. 270.), I cannot refrain from expressing my dissent to the common method of passing a couching-needle at once in front of the cataract. On the contrary, it seems safer to direct the extremity of the instrument immediately over the opaque lens, and, in the first instance, to depress it a little downward, by means of the flat surface of the needle, in order to make room for the safe conveyance of the instrument between the cataract and corpus ciliare, in front of the diseased crystalline and its capsule; taking care, in this latter step of the operation, to keep the marked side of the handle forward, by which means the point of the needle will be in an opposite direction to the iris, and will come into contact with the diseased body, and the membrane binding it down in the fossula of the vitreous humour. When this has been done, and the case is a firm cataract, the instrument will be visible through the pupil. Scarpa now pushes its point transversely, as near as possible the margin of the lens, on the side next the internal angle of the eye, taking strict care to keep it continually turned backward. He then inclines the handle of the instrument towards himself, whereby its point is directed through the capsule, into the substance of the opaque lens; and, on making a movement of the needle, describing the segment of a circle, at the same instant inclining it downward and backward, he lacerates the former, and conveys it, in the generality of cases, with the latter, deeply into the vitreous humour. Perhaps, the greatest inconvenience of Scarpa's method is that likely to arise from passing the point of the needle into a firm cataract, whereby the opaque body may become fixed on the end of the instrument, and follow it when it is withdrawn instead of remaining below the pupil. Indeed Mr. Guthrie considers it a point of great importance in this operation never to pierce the lens, and that this rule should even be followed, "*if necessary*, at the expense of the ciliary processes," of which, he thinks, the principal utility terminates with the removal of the lens. (*Operative Surgery of the Eye*, p. 271.) To me, who prefer Scarpa's manner of depressing the cataract a little in the first instance, so as to make room for the passage of the needle between it and the ciliary processes into the posterior chamber, the necessity of ever wounding those processes, for the purpose of avoiding to pierce the lens, seems hardly conceivable. At the same time, I believe with Mr. Guthrie, that, in the common practice of moving the needle from the posterior chamber to the upper part of the cataract, the ciliary processes must suffer more or less injury.

Beer, as I have explained, gives the preference to a spear-pointed straight needle, one flat surface of which, at the period of its first introduction into the eye, is turned upwards; the other, downwards; one edge, directed towards the nasal, the other, towards the temporal canthus, and the point towards the centre of the eyeball. Beer prefers this mode of proceeding, in order to avoid moving the lens too soon out of its natural situation, whereby the subsequent manœuvres of depression or reclination, he thinks, would be rendered very uncertain and incomplete. He also recommends the surgeon to support his hand in some measure on the patient's cheek, by means of the little finger, so as to have it in his power to check the too sudden and deep entrance of the instrument into the eye, liable to happen when the broadest part of the spear-point has passed through the sclerotica. (*Lehre, &c.* b. ii. p. 354.)

It happened, unfortunately for the credit of the operation of depression, that Petit admonished surgeons to beware of wounding the anterior layer of the crystalline capsule: he had an idea, that, when this caution was observed, the vitreous humour would afterwards fill up the space previously occupied by the lens, and that thus the refracting powers of the eye might become as strong as in the natural state, and the necessity for using spectacles be considerably obviated. But, we are now apprised, that leaving this very membrane, from which Petit anticipated such great utility, even were it practicable to leave it constantly uninjured in its natural situation, would be one of the worst inculcations that could possibly be established: for, in many cases, where extraction proves fruitless; in some, where depression fails; the want of success is owing to a subsequent opacity of the crystalline capsule; in short, blindness is reproduced by the secondary membranous cataract. It seems more than probable, that, in some of the instances, where the opaque lens has been said to have risen again, nothing more has happened than the disease in question. Therefore, notwithstanding the whole capsule in the majority of cases, may be depressed with the lens out of the axis of vision, as it is not a constant occurrence, I cannot too strongly enforce the propriety of extirpating, as it were, every source and seat of the cataract in the same operation; and, in imitation of the celebrated Scarpa, who is entitled to the honour of having first pointed out the great importance of this practice, I shall presume to recommend, as a general rule in couching, always to lacerate the front layer of the capsule, whether in an opaque or transparent state.

The capsule of the lens may retain its usual transparency, while the lens itself is in an opaque state. In this case, an inexperienced operator might, from the blackness of the pupil, suppose, not only that he had removed the lens, but also the capsule from the axis of sight; and, having depressed the cataract, he might unintentionally leave this membrane entire in its natural situation. Therefore, if there should be any reason for suspecting, that the anterior layer of the capsule has escaped laceration; if, in other words, the resistance made to moving the convexity of the instrument forward, towards the pupil, should give rise to such a suspicion; for the sake of removing all doubt, it is proper to communicate to the needle a gentle rotatory motion, by which its point will be turned forward, and disengaged, through the transparent capsule, opposite the pupil: then, by repeating a few movements downward and backward, it will be so freely rent with the needle, as to occasion no future trouble.

Beer divides both the operations of couching and reclination into three stages: the first is that in which the needle is introduced into the eye; the second, that in which it is passed into the posterior chamber, and placed across the anterior surface of the cataract; and the third, that in which the depression, or reclination of the cataract is accomplished.

If a straight, slender, spear-pointed needle be used, and the second stage of the operation be completed by the introduction of the extremity of the instrument into the posterior chamber (which I particularly recommended to be done in the manner directed by Scarpa), then, according to the directions given by Professor Beer, when depression is indicated, the needle is to be immediately carried to the uppermost part of the cataract, with its point directed somewhat obliquely downwards; and with that surface, which, in the first instance, was applied to the front of the lens, now placed upon its superior edge; then the opaque body is to be pushed rather obliquely, downwards and outwards, so far below the pupil, that it can no longer be distinguished. After this has been done, the needle is to be gently raised, in order to see whether the cataract will continue depressed; and, if it be found to do so, the needle is to be withdrawn in the same direction in which it was introduced.

On the other hand, says Beer, when reclination is to be practised, the needle, after being applied to the front surface of the cataract, is not to be moved further out of the position of the second stage of the operation, but its handle is merely to be raised diagonally forwards, whereby the cataract will be pressed downwards and outwards to the bottom of the vitreous humour, and turned in the manner already specified. Beer has delivered what appears to me one valuable piece of advice for operators on the eye with the needle: whether depression, or reclination, is to be done, says he, a surgeon can only use this instrument without injurious consequences on the principle of a lever; and every attempt to press with the whole length of the instrument, is not only ineffectual with respect to the progress of the operation, but so hurtful to the eye, that bad effects must follow, as may be readily conceived, when it is recollected how violently the ciliary nerves must be stretched.

As for the modifications of the manœuvres, rendered necessary by the varieties of cataracts, they are (says Beer) so unimportant in all cases of depression, that a young operator will easily understand them himself. But, things are far otherwise in the practice of reclination; for, when the case is a completely formed *capsulo-lenticular cataract*, and the opaque capsule is so thin as to be torn during the turning of the lens, the latter body will indeed be placed in the intended position at the bottom of the eye, but the capsule itself, which has merely been lacerated, must form a secondary cataract, unless the surgeon, with a sharp double-edged needle, immediately divide it in every direction, and remove it as far as possible from the pupil. When, during reclination, a *softish lens*, or one which is *pulpy* to its very nucleus, breaks into several pieces, it is necessary, in order not to have afterwards a considerable secondary lenticular cataract, to put the larger fragments separately in a state of reclination, while the smaller ones may either be depressed, or (if the pupil be not too much contracted) they may be pushed into the anterior chamber, where they will soon be absorbed. *When the cataract is partially adherent to the uvea,* Beer recommends an endeavour to be first made, with the edge of the needle (which is to be introduced flat between the cataract and the uvea, above or below the adhesion) to separate the adherent parts before the attempt at reclination is made. Should it be a cataract, which always rises again as soon as the needle is taken from it, though the instrument has not pierced it at all, the case is termed the *elastic cataract*, in which the lens is not only firmly adherent to its own capsule, but this also to the membrana hyaloidea. Here Beer thinks, that the best plan is first to carry the needle to the uppermost point of the posterior surface of the lens, and by means of perpendicular movements of the cutting part of the instrument, to endeavour completely to loosen this preternatural adhesion of the cataract to the vitreous humour, when reclination may be tried again, and will perhaps succeed. But, says Beer, when the continual rising of the cataract is caused by the operator's running the needle into it, the instrument must either be withdrawn far enough out of the eye to let it be again properly brought into the posterior chamber, when reclination may be effectually repeated; or if the cataract be firmly fixed on the needle at the bottom of the eye, the instrument should not be raised again, but, previously to being withdrawn, it should be rotated a couple of times on its axis, whereby the pierced lens will be more easily disengaged from the needle, and at last continue depressed. (*Lehre von den Augenkr.* b. ii. p. 356—358.)

In addition to Beer's directions for couching and reclination, the following observations seem to me to merit attention:—

When the case is a *fluid* or *milky* cataract, the operator frequently finds, that, on passing the point of the couching-needle through the anterior layer of the capsule, its white milky contents instantly flow out; and, spreading like a cloud over the two chambers of the aqueous humour, completely conceal the pupil, the iris, and the instrument from his view; who, however, ought never to be discouraged at this event. Although it seems to me most prudent, to postpone the completion of operations with the needle, in the example of blood concealing the pupil, in the first step of couching, and not to renew any attempt before the aqueous humour has recovered its transparency; I am inclined to adopt this sentiment, chiefly because the species of cataract is, in this circumstance, generally unknown to the operator, consequently he must be absolutely incapable of employing that method of couching, which the peculiarities of the case may demand. Speaking of this case, however, Beer says, "The surgeon must hasten the completion of extraction or reclination, though possibly the operation may not always admit of being continued; or if gone on with, it must be done, as it were, blindfold." (*Lehre, &c.* b. ii. p. 361.) When a milky fluid blends itself with the aqueous humour, and prevents the surgeon from seeing the iris and pupil, this event is itself a source of information to him, inasmuch as it gives him a perfect insight into the nature of the cataract which he is treating, and instructs him what method of operating it is his duty to adopt. The surgeon, guided by his anatomical knowledge of the eye, should make the curved point of the needle describe the segment of a circle, from the inner towards the outer canthus, and in a direction backward, as if he had to depress a firm cataract. (*Scarpa.*) Thus he will succeed in lacerating, as much as is necessary, the anterior layer of the capsule, upon which, in a great measure, the perfect success of the operation depends; and, not only in the milky, but almost every other species of cataract.

The extravasation of the milky fluid in the chambers of the aqueous humour, spontaneously disappears very soon after the operation, and leaves the pupil of its accustomed transparency. "In twelve cases of a dissolved lens, on which I have operated," says Latta, "the dissolution was so complete, that, on entering the needle into the capsule of the lens, the whole was mixed with the aqueous humour, and all that could be done was to destroy the capsule as completely as possible, that all the milky matter might be evacuated. In ten of these cases, vision was almost completely restored in four weeks from the operation." Mr. Pott, in treating of this circumstance, viz. the effusion of the fluid contents of the capsule into the aqueous humour, observes that, so far from being an unlucky one, and preventive of success, it proves, on the contrary, productive of all the benefit which can be derived from the most successful depression or extraction, as he has often and often seen.

When the cataract is of a *soft* or *caseous* description, the particles of which it is composed will frequently elude all efforts made with the needle to depress them, and will continue behind the pupil in the axis of vision. This has been adduced as one instance that baffles the efficacy of couching, and may really seem, to the inexperienced, an unfortunate circumstance. It often happens in the operation of extraction, that fragments of opaque matter are unavoidably overlooked and left behind; yet Richter confesses, that such matter is frequently removed by the absorbents. Supposing a caseous cataract were not sufficiently broken and disturbed in the first operation, and that, consequently, the absorbents did not completely remove it, such a state might possibly require a re-application of the instrument; but this does not generally occur, and is the worst that can happen. It is quite impossible to determine *à priori*, what effect will result from the most trivial disturbance of a cataract; its entire absorption may, in some instances, follow, while, in others, a repetition of the operation becomes necessary for the restoration of sight. Even where the whole firm lens has reascended behind the pupil, as Latta and Hey confirm, the absorbents have superseded the necessity for couching again. The disappearance of the opaque particles of cataracts was, in all times and in all ages, a fact of such conspicuousness, that, as appears from the authority of Barbette and others, it was recorded, even previously to the discovery of the system of lymphatic vessels in the body. Indeed, the modern observations of Scarpa and others, so strongly corroborate the account, which I have given, of the vigorous action of the absorbents, in the two chambers of the aqueous humour, and, particularly, in the anterior one, that, from the moment the case is discovered to be a soft or caseous cataract, it seems quite unnecessary to make any further attempt to depress it into the vitrous humour. Mr. Pott sometimes, in this circumstance, made no attempt of this kind, but contented himself with a free laceration of the capsule, and, after turning the needle round and round, between his finger and thumb, within the body of the crystalline, left all the parts in their natural situation, where he hardly ever knew them fail of dissolving so entirely, as not to leave the smallest vestige of a cataract. This eminent surgeon even practised occasionally what Beer sanctions, and Scarpa so strongly recommends, at this day; for he sometimes pushed the firm part of such cataracts through the pupil into the anterior chamber, where it always disappeared, without producing the least inconvenience: we must, at the same time, add, that he thought this method wrong, not on account of its inefficacy, but an apprehension that it would be apt to produce an irregularity of the pupil, one of the worst inconveniences attending the operation of extraction. But the deformity of the pupil, after extraction, seems to proceed either from an actual laceration of the iris, or a forcible distention of the pupil, by the passage of large cataracts through it, a kind of cause that would not be present in pushing the broken portions of a caseous lens into the anterior chamber. Hence, it does not seem warrantable to reject this very efficacious plan of treatment. It is well deserving of notice, that Mr. Hey, who has several times seen the whole opaque nucleus and very frequently small opaque portions fall into the anterior chamber, makes this remark: — "Indeed, if the cataract could, in all cases, be brought into the anterior chamber of the eye, without injury to the iris, *it would be the best method of performing the operation.*" What the same author also observes, in the subsequent part of his work, is strikingly corroborative of the efficacy of Scarpa's practice. The practice of the Italian professor consists, in lacerating the anterior portion of the crystalline capsule, to the extent of the diameter of the pupil, in a moderately dilated state; in breaking the pappy substance of the diseased lens piecemeal; and in pushing the fragments through the pupil, into the anterior chamber, where they are gradually absorbed.

One great advantage of couching, insisted upon by Scarpa, depends upon its generally removing the capsule, at the same time with the lens, from the passage of the rays of light to the retina. Sometimes, however, this desirable event, by which the patient is extricated from the danger of a *secondary membranous cataract*, does not take place. What most frequently constitutes the secondary membranous cataract, is the anterior half of the capsule, which not having been removed, or sufficiently broken, in a previous operation, continues more or less entire in its natural situation, afterwards becomes opaque, and thus impedes the free transmission of the rays of light to the seat of vision. Sometimes the secondary membranous cataract presents itself beyond the pupil, in the form of membranous flakes, apparently floating in the aqueous humour, and shutting up the pupil: at other times, it appears in the form of triangular membranes, with their bases affixed to the *membrana hyaloidea*, and their points directed towards the centre of the pupil. When there is only a minute membranous flake suspended in the posterior chamber, Scarpa thinks it by no means necessary for the patient to submit to another operation; vision is tolerably perfect, and, in time, the small particle of opaque matter will spontaneously disappear. But when the secondary membranous cataract consists of a collection of opaque fragments of the capsule, accumulated so as either in a great degree or entirely to close the pupil; or when the disease consists of the whole anterior half of the opaque capsule, neglected in a prior operation, and continuing adherent in its natural situation, it is indispensable to operate again; for, although, in the first case, there may be good reason to hope, that the collection of membranous fragments might, in time, disappear, yet it would be unjustifiable to detain the patient for weeks and months in a state of anxiety and blindness, when a safe and simple operation would restore him, in a very short space of time, to the enjoyment of this most useful of the senses. In the second case, says Scarpa, it is absolutely indispensable: for while the capsule remains adherent to its natural connections, the opacity seldom disappears, and may even expand over a larger portion of the pupil. He advises the operation to be performed as follows: — When the aperture in the iris is obstructed by a collection of membranous flakes, detached from the membrana hyaloidea, the curved needle should be introduced, with the usual precaution of keeping its convexity forward, its point backward, until arrived behind the mass of opaque matter; the surgeon is then to turn the point of the needle towards the pupil, and is to push through this opening regularly one after another, all the opaque particles into the anterior chamber, where, as we have before noticed, absorption seems to be carried on more vigorously than behind the pupil. All endeavours to depress them into the vitreous humour, Scarpa has found to be in vain; for scarcely is the couching-needle withdrawn when they all reappear at the pupil, as if (to use his own phrase) carried thither by a current; but, when forced into the anterior chamber, besides being incapable of blocking up the pupil, they lie, without inconvenience, at the bottom of that cavity, and in a few weeks are entirely absorbed.

When the *secondary membranous cataract* consists of the whole anterior layer of the crystalline capsule, or of several portions of it connected with the membrana hyaloidea, Scarpa, after cautiously turning the point of the needle towards the pupil, pierces the opaque capsule: or, if there be any interspace, he passes the point of the instrument through it; then, having turned it again backward, he conveys it, as near as possible, to the attachment of the membranous cataract, and after piercing the capsule, or each portion of it successively, and sometimes carefully rolling the handle of the instrument between his finger and thumb, so as to twist the capsule round its extremity, he thus breaks the cataract, as far as it is practicable, at every point of its circumference. The portions of membrane, by this means separated from their adhesions, are next cautiously pushed, with the point of the couching-needle turned forward, through the pupil, into the anterior chamber. In these manœuvres, the operator must use the utmost caution not to injure the iris and ciliary processes; for upon this circumstance depends the avoidance of bad symptoms after the operation, notwithstanding its duration may be long, and the necessary movements of the needle frequently repeated. If a part of the membranous cataract be found adherent to the iris (a complication, that will be indicated when, upon moving it, backward or downward with the needle, the pupil alters its shape, and, from being circular, becomes of an oval, or irregular figure), even more caution is required than in the foregoing case, so as to make repeated, but delicate movements of the needle, to separate the membranous opacity, without injuring the iris. Beer's mode of proceeding in such a case, I have already described.

Scarpa does not deem it necessary to vary the plan of operating above explained, if occasionally the cataract be formed of the posterior layer of the capsule. And, according to this author, the same plan also succeeds in those rare instances, where the substance itself of the crystalline wastes, and is almost completely absorbed, leaving the capsule opaque, and including, at most, only a small nucleus, not larger than a pin's head. Scarpa terms it the *primary membranous cataract*, and describes it as being met with in children, or young people under the age of twenty; as being characterised by a certain transparency, and similitude to a cobweb; by a whitish opaque point, either at its centre or circumference; and, by a streaked and reticulated appearance: he adds, that whosoever attempts to depress such a cataract is baffled, as it re-appears behind the pupil, soon after the operation: he recommends breaking it freely with the curved extremity of the couching-needle, and pushing its fragments into the anterior chamber, where they are gradually absorbed in the course of about three weeks.

No other topical application is generally requisite, after the operation, but a small compress of fine linen upon each eye; and the patient ought to be kept in a quiet, moderately darkened room. On the following morning, a dose of some mild purgative salt, such as the sulphate of soda, or magnesia, may usually be administered, with advantage. When the inflammation exceeds the ordinary bounds, then the treatment applicable to iritis becomes proper. (See *Ophthalmy.*)

Beer remarks, that although, after extraction, very cautious trials of the sight are indispensable, they are by no means proper after depression or reclination; for the action of the muscles of the eye, in the inspection of objects at various distances, is very liable to make the opaque body rise again. Hence, as soon as the pupil is clear, Beer recommends covering both eyes (even when one only has been operated upon) with a plaster, and simple linen compress, which last is to be fastened on the forehead with a common bandage. The same experienced operator also enjoins perfect quietude of the body and head for some days. The patient, he says, may either lie in bed, or sit in an arm-chair, as may be most agreeable, care being taken to avoid all sudden motions. The most proper food for the patient is such as is easily digested, not too nutritious, and does not require much mastication. Every thing must be avoided, which has a tendency to excite inflammation in the eye. On the third or fourth day, the eye should be opened, and afterwards be merely protected by a green silk eye-screen, which should also be gradually dispensed with. The patient should be careful to do whatever is agreeable to the eye, which has been operated upon, and as carefully avoid every thing which irritates it, or causes a disagreeable sensation in it, a difficulty of opening the eyelids, or keeping them open, a discharge of tears, or a redness of the white of the eye, &c.

Of the thrombus under the conjunctiva, sometimes caused by the prick of the needle, and of the readily bleeding granulations which occasionally shoot up at the puncture, I need not here particularly speak. For relieving the obstinate vomiting, sometimes excited by injury of the ciliary nerves, or that of the retina, Beer recommends castor, musk, and opium, except when the eye is in a state of inflammation, in which circumstance, antiphlogistic treatment is preferable. Such vomiting, Beer joins other writers in believing, is often produced by a firm lens being depressed too far, so as to injure the retina; a case, however, which is usually combined with a suddenly produced, complete, or incomplete amaurosis. Here, unless the position of the lens can be changed by a sudden movement of the head, the above class of medicines will be of no use. This kind of amaurosis may also take place, without any vomiting, and, as Beer has had opportunities of remarking, it will not always subside, even though the cataract be made to rise again. The same amaurotic affection may also result from the surgeon hurting the retina by pushing the needle too deeply against this membrane. According to Beer, the ophthalmy, liable to happen in these cases, as well as after extraction and keratonyxis, is always most severe in the iris and neighbouring textures. (*Von den Augenkr.* b. ii. p. 361—363.)

I cannot help remarking how judicious it is never to attempt too much at one time in any mode of couching. It happens in this, as in most other branches of operative surgery, that celerity is too often mistaken for skill: the operator should not only be slow and deliberate in achieving his purpose; he should be taught to consider, that the repetition of couching may, like the puncture of a vein, be safely and advantageously put in practice again and again; and with far greater security than if, for the sake of appearing expeditious, or avoiding the temporary semblance of failure, a bolder use of the couching-needle should be made, than the delicate structure of the eye warrants. We read, in Mr. Hey's *Practical Observations on Surgery*, that he couched one eye seven times, before perfect success was obtained; had he been less patient, and endeavoured to effect by one or two rough applications of the instrument, what he achieved by seven efforts of a gentler description, it is highly probable, that the structure of the eye would have been so impaired, as well as the consequent ophthalmy so violent, as to have utterly prevented the restoration of sight.

All the various methods of couching having now been described, I subjoin the sentiments of Beer, respecting the circumstances, by which the choice of depression, or reclination, ought to be regulated. According to this author, when the cataract is very firm, or moderately so, with a scabrous surface, or the case is what has been already described under the name of *encysted cataract*, or when the cataract consists of any tough membrane, both depression and reclination can only be a palliative remedy; for, says he, none of these cataracts after the operation can be dissolved and absorbed, but must remain in the eye, as a foreign unorganised body, ready at every opportunity to rise again, and partially or completely blind the patient anew. Beer assures us, that he has carefully examined the eyes of persons after death, on whom depression or reclination had been practised, in some instances, twenty or more years previously; but, in almost all the examples, the lens was found firm and undissolved, or at most only diminished, with or without its capsule. Membranous cataracts were very trivially lessened; though they had quite lost their rough consistence, and were changed into a firmish white mass. In a living person, Beer says, he saw an instance, in which a cataract rose again after it had been depressed by Hilmer thirty years previously: it was small, angular, and, when the pupil was dilated, it floated from one chamber of the eye into the other. When extracted, which was done with complete success, it was found to be almost ossified. In 1805, Beer extracted from a woman, forty years of age, a very large, hard, yellowish-white lenticular cataract, which had been in the anterior chamber twenty-six years. The lens had been thus displaced by a blow received on the eye from the branch of a tree. Nor has Beer ever yet seen a case, in which a cataract of a semi-firm consistence was dissolved and absorbed. (*Von den Augenkr.* b. ii. p. 363.) In old subjects, absorption is excessively languid, and the lens often very hard. Dupuytren, who admits these facts as arguments against the use of needles, states that he had seen examples, where the lens, after it had been displaced, more than two years, was completely unchanged. Yet, in many old persons, extraction is rendered difficult by the sunk state of the eye, and the prominence of the border of the orbit. (See *Clin. Chir.* t. i. p. 45.) Had Beer confined his statements to what happens to certain cataracts, on which depression or reclination, strictly so called, had been practised, I should have been disposed to accede to the general assertion, respecting the great length of time which a firm or tough capsular cataract remains in the vitreous humour, undissolved and unabsorbed. But, if he mean, that the same thing is generally the case with cataracts broken piecemeal, and placed in the aqueous humour, we know, that such a representation is contradicted by the experience of an infinite number of the highest authorities in surgery. Nay, notwithstanding the case adduced of a bony lens having remained in the aqueous humor twenty-six years, I am disposed to think, that Beer himself does not intend to question the absorption of the fragments of cataracts in the aqueous humour, particularly as at p. 357. b. ii. he sanctions pushing the fragments of semi-firm cataracts through the pupil into the anterior chamber, where, he confesses, that *they are soon absorbed.*

Beer thinks, that, in general, depression and reclination are indicated only in cases, in which extraction is absolutely impracticable, or attended with too great difficulty, as will be better understood when this operation is considered. As examples of this kind, Beer specifies an extensive adhesion of the iris to the cornea; a very flat cornea, and, of course, so small an anterior chamber, that an incision of proper size in the cornea cannot be made; a broad arcus senilis; an habitually contracted pupil (incapable of being artificially dilated); an eye much sunk in the orbit, with a small fissure between the eyelids; eyes affected with incessant convulsive motions; a partial adhesion of the cataract to the uvea; unappeasable timidity in the patient; and an impossibility of managing him during and after the operation, in consequence of his childhood or stupidity. Amongst the circumstances, enumerated by Mr. Middlemore as rendering the operation of depression, or reclination more advantageous than extraction, is an emaciated feeble condition of the patient, which, if the latter operation were performed, might interfere with the union of the wound in the cornea, and be followed by ulceration, sloughing, and staphyloma of that texture. (See *Middlemore on Dis. of the Eye;* vol. ii. p. 111.) The same gentleman also expresses his opinion, that in certain examples of hard cataract, where extraction cannot be performed with propriety, reclination is generally preferable, to depression, because not so likely to be followed by a rising of the lens again, or to cause pressure on the retina. He adds, indeed, direct depression of the lens beneath the pupil is very seldom practised now, as it is in a great measure superseded by extraction and reclination. (p. 112.)

With regard to the question whether depression or reclination should be preferred, Beer is of opinion, that the first method is indicated only when the dimensions of the cataract are small, and, consequently, when there is room enough for it to be placed below the pupil without the ciliary processes being torn from the annulus ciliaris. Such cases are the *dry siliquose cataract* (the *primary membranous cataract*, of Scarpa), when perfectly free from adhesions to the uvea; the true *lenticular secondary cataract*, produced by the small but firm fragments of the lens having been left, or risen again; and the genuine *secondary membranous* or *capsular cataract.* On the other hand, reclination is to be preferred, when, together with the above objections to extraction, the surgeon has to deal with a fully formed, very *hard lenticular* or *capsulo-lenticular cataract;* or with a case of the latter kind, complicated with partial adhesions to the uvea; or when the case is a *secondary capsular cataract*, similarly circumstanced; a *secondary cataract of lymph;* a *gypsum cataract;* or there is reason to apprehend a considerable tendency in the blood-vessels of the interior of the eye to become varicose. (*Lehre von den Augenkr.* b. ii. p. 365.)

The manner of operating with the needle upon the congenital cataracts of children will be hereafter explained.

The operation, most frequently performed in the United States, is that of passing the needle of Adams, Scarpa, Saunders, or Hey through the sclerotica, immediately behind the iris, and then lacerating the capsule, or the lens itself, and permitting the aqueous humour to act upon it, either by pressing the fragments of the lens through the pupil into the anterior chamber, or, where this is impracticable, leaving them *in situ.* One of the most successful operators in the United States, is Dr. John Harper, of Baltimore, and he seldom adopts any other operation, than this, which he repeats, as often as necessary, on the same eye. In the case of a young lady, Dr. Reese performed it on both eyes at once, and to promote absorption gave her the blue pill: in three weeks, her vision was restored, although she had been blind twelve years. Depression seems to have but few advocates in the United States; nor is extraction often preferred there, even for hard cataracts. (See *Reese*, in Amer. ed. of this Dict.)

EXTRACTION OF THE CATARACT.

From some passages in the works of Rhazes, Haly, and Avicenna, specified by Mr. Guthrie, it is sufficiently clear, that the practice of opening the cornea for the removal of cataracts was not unknown to the ancients. Rhazes says, that about the end of the first century, Antyllus opened the cornea, and drew the cataract out of the eye with a fine needle, in which practice he was followed by Lathyrion. However, while doubts were entertained, respecting the true seat of the cataract, it is hardly to be supposed, that this mode of treatment could have been frequently adopted; but, as soon as it was fully proved that the true cataract was an opacity of the crystalline lens; that the loss of sight would not be occasioned by the removal of this body; that the cornea might be divided without danger; and that the aqueous humour would be quickly regenerated; the mode of cure, by extracting the cataract out of the eye, would naturally present itself. (*Wenzel.*)

Freytag is perhaps the first in modern times who made an attempt to extract the cataract: this was about the close of the 17th century. After him, Lotterius, of Turin, performed the operation. But nobody has so strong a claim as M. Daviel to the honour of bringing the merits of the practice before the public; and he not only adopted it himself, but published the first good description of it. (*Sur une Nouvelle Méthode de guérir la Cataracte par l'Extraction du Cristallin*, 1747. *Also Mémoires de l' Acad. Royale de Chirurgie*, t. ii. 4to. 1753.) Two cases in which the cataract had accidentally slipped through the pupil into the anterior chamber, whence they were extracted in the years 1707 and 1708 by Mery and Petit, as related by St. Ives, seem to have had considerable influence in bringing about the regular performance of this method of removing the cataract; for, they served as an encouragement to Daviel, by whom the practice was completely established. The operation was afterwards brought considerably nearer to perfection by the ingenuity and industry of Wenzel. (*Brambilla Instrumentarium Chir. Austriacum*, 1782. p. 71.)

Indeed, with the valuable instructions, which Ware and Beer have still more recently furnished, the extraction of the cataract may now be regarded as brought to the highest state of improvement. According to Beer, it admits of division into three stages, the first of which, as in depression and reclination, is the most important; because, unless it be performed exactly as it ought to be, the operation would be very liable to fail, and it is exceedingly difficult to make amends for any fault committed in this early part of the proceedings. The first stage consists in making an effectual opening in the cornea with a suitable knife. The second, in dividing the anterior layer of the capsule, which, says Beer, should not be merely punctured, or torn with a bluntish instrument, but cut with a sharp two-edged lance-pointed needle, and, as much as possible, annihilated. In the third stage, the expulsion of the cataract from the eye is effected either by the well-regulated action of the eyeball itself, or by the assistance of art. But, as Beer remarks, they who have learned the manner of effectually and skilfully cutting the cornea, will frequently have the pleasure to find the two last stages beneficially converted into one, and the operation in general soon and expeditiously completed. (*Von den Augenkr.* b. ii. p. 366.)

On the evening, prior to the operation, and also the next morning, belladonna should be applied to the eyebrow, to produce an expansion of the pupil. This is much better, than dropping the solution of belladonna into the eyes, which has a tendency to render them irritable, and sometimes, in spite of every precaution, a little of the belladonna may remain in the folds of the conjunctiva, and insinuate itself between the edges of the incision in the cornea. The dilatation of the pupil will lessen the risk of the iris being wounded, and will enable the operator to pass the knife with greater certainty and celerity across the anterior chamber. When the pupil is small on the morning of the operation, Mr. Middlemore drops a strong solution of extract of hyosciamus (one drachm to an ounce of water) into the eyes, as suggested by Himley and Wishart. By the agency of these drops, the pupil becomes largely dilated, with much less pain than follows the use of belladonna drops. (See *Middlemore on Dis. of the Eye*, vol. 2. p. 128.)

The knives, used by Richter, Wenzel, Ware, and Beer, are all of them more or less different; but, they agree in the common quality of completely filling up the wound, as it is extended, so that none of the vitreous humour can escape before the division of the cornea is finished.

Wenzel's knife resembles the common lancet employed in bleeding, excepting that its blade is a little longer, and not quite so broad. Its edges are straight, and the blade is an inch and a half (eighteen lines) long, and a quarter of an inch (three lines) broad in the widest part of it, which is at the base. From this part it gradually becomes narrower towards the point; so that this breadth of a quarter of an inch extends only to the space of about one-third of an inch from the base; and, for the space of half an inch from the point, it is no more than one-eighth of an inch broad.

The knife employed by the late Mr. Ware, is, in regard to its dimensions, not unlike that employed by Wenzel. The principal difference is, that it is less spear-pointed; in consequence of which, when this latter instrument has transfixed the cornea, its lower or cutting edge will sooner pass below the inferior margin of the pupil, than the knife used by Wenzel. On this account, Mr. Ware believed, that the iris would be less likely to be entangled under the knife which he recommended, than under Wenzel's, when the instrument begins to cut its way downwards, and the aqueous humour is discharged. Mr. Ware particularly advises great care to be taken to let the knife increase gradually in thickness from the point to the handle; by which means, if it be conducted steadily through the cornea, it will be next to an impossibility, that any part of the aqueous humour can escape, before the section is begun downwards; and, consequently, during this time, the cornea will preserve its due convexity. But if the blade should not increase in thickness from the point, or if it be incurvated much in its back or edge, the aqueous humour will unavoidably escape, before the puncture is completed; and the iris, being brought under the edge of the knife, will be in great danger of being wounded by it. One of the best cataract knives is that employed by Beer. A double cataract knife is used by Jaeger. "It is composed of a Beer's blade affixed to a handle; a smaller blade, of the same form, having its flat side in contact with the other knife; and a button screw. When not in use, the second blade is situated within the outline of the first, with which the cornea is transfixed. It is introduced in the same way as Beer's knife, not parallel, but nearly perpendicular to the cornea, and afterwards carried across the eye, exactly like the single knife, with the posterior surface of the fixed blade parallel to the iris, at the usual distance from the junction of the cornea with the sclerotica. When the point of the greater knife has transfixed the cornea at the inner side, pressure is made on the button-head of the smaller blade, which slides in a groove in the upper part of the handle, with the thumb, with which it is pushed steadily forward, whilst the greater blade keeps the ball firmly fixed, and thus the section of the cornea is completed," &c. (See *Loudon's Short Inquiry into the Principal Causes of the Unsuccessful Termination of Extraction, &c.* 1826.) Amongst the advantages imputed to Jaeger's knife are those of not injuring parts at the inner angle; of not making the incision too small for the extraction of the lens; and of less of the aqueous humour being discharged previously to the iris being out of danger. Baron Graefe uses also a knife of his own invention, the end of which is a little curved, so that when it has passed through the cornea, it is calculated to draw the eye in any desirable direction more surely. The sentiments of Richter, Scarpa, Beer, and others, about the position of the patient in the operation, and the mode of fixing the eye, have been already noticed in a foregoing section.

The operator is to sit in front of the patient, but upon a considerably higher stool, or chair than the latter, as already explained, and his legs are to be placed on each side of the patient, and his right foot sufficiently raised by a stool for his elbow to rest upon his knee, whilst the knife is on a level with the patient's eye. (See *Guthrie's Operative Surgery of the Eye*, p. 295.)

When the right eye is to be operated upon, and the operation is to be done according to the preceding directions, the surgeon must of course use his left hand: but if he be not an ambidexter, "the patient must be placed on his back on a table, or on a mattress, or a firm bedstead with a head, so that the operator can stand behind without inconvenience. The head being supported on a cushion, the operator raises the upper eyelid himself, and fixes the eyeball, whilst an assistant depresses the lower lid, if necessary. The incision is then to be made with the same precaution, as in the other method, the knife being held with its edges towards the thumb, and the little finger towards the temple, instead of the cheek. The division of the cornea upwards in this manner is the operation generally preferred by Mr. Alexander for both eyes, when not specially contra-indicated." (*Guthrie*, p. 318.) In an operation which I lately saw this gentleman perform, he stood behind a kind of easy chair, on the upper part of the back of which he kept the head steadily supported while he divided the upper segment of the cornea. As a general rule, Mr. Guthrie thinks that the operation of extraction should always be done upwards, and this regulates the position of the patient and surgeon. The former, he observes, should be seated in an arm-chair, the back of which should be low enough to support the head when gently inclined backwards. (*On the Certainty, &c. of Extraction*, p. 9.) For the operation on the right eye, Mr. Guthrie recommends the surgeon to place himself behind the patient, and observes, that he will usually find it necessary to stand on a stool, in order to raise himself to such a height that he may readily lean over, and have his hands in that position which is most convenient to him. The patient's head being a little inclined backwards, and duly supported by the cushion, or back of the chair, the surgeon, leaning over from behind, brings the two forefingers of the left hand over the forehead gently down on the eyelid, and raises it up tenderly, so as to fix it against the upper edge of the orbit, and to retain it there perfectly with the end of the index finger only. He should be able to do this, and also to make a little pressure on the eyeball, in order to fix it at the moment the incision is begun. As soon as the index finger, is in this position, the second finger moves the upper and lowers the under lid, fixing it against the edge of the orbit below. "The left eye may be opened, and fixed in a similar manner: or the surgeon, standing before the patient, raises the upper lid with the side of the forefinger of the left hand, and depresses the under lid with the thumb, the hand being over the nose." (*Guthrie, Op.* cit., p. 9.) This gentleman prefers leaving the other eye uncovered.

When the patient is placed in the sitting posture, and syncope occurs, the completion of the operation may be prevented. Dupuytren used to place his patients in bed. The recumbent position is thus spoken of by Ware. "It appears to me (says he) that the surgeon will perform the operation with more composure, if the patient be laid on a table, than if he be seated in a chair; but, except in infants, this is not indispensable, if the patient's steadiness can be depended upon," (p. 372.) Another writer observes, that, if the patient be placed in the recumbent posture, the head is prevented from receding, and the operator can rest his elbow upon the table, support his arm upon the patient's chest, and his hand upon his cheek. (*Middlemore on Dis. of the Eye*, vol. ii. p. 130.) This gentleman follows the most common plan of covering the eye, which is about to be operated upon, with a roller or some light bandage.

The danger likely to arise from undue pressure, Mr. Ware observes, can only take place after the instrument has made an opening in the eye; but the pressure ought to be removed the instant the knife is carried through the cornea, and before any attempt is made to divide this tunic downwards. To understand this subject better, however, the reader should know, that Mr. Ware divided the incision of the cornea into two distinct processes; the first of which may be called *punctuation*, and the second *section*. So long as the knife fills up the aperture, in which it is inserted, that is, until it has passed through both sides of the cornea, and its extremity has advanced some way beyond this tunic, the aqueous humour cannot be discharged, and pressure may be continued with safety. The punctuation of the cornea being completed, the purpose of pressure is fully answered: and, if such pressure be continued, when the section of the cornea begins, instead of being useful, it will be hurtful. Mr. Ware recommends the cornea to be cut in the following way: —

The operator is to place the fore and middle fingers of the left hand upon the tunica conjunctiva, just below, and a little on the inside of the cornea. At the same time, the assistant, who supports the head, is to apply one, or, if the eye projects sufficiently, two of his fingers upon the conjunctiva, a little on the inside and above the cornea. The fingers of the operator and assistant, thus opposed to each other, will fix the eye, and prevent the lids from closing. The point of the knife is to enter the outside of the cornea, a little above its transverse diameter, and just before its connection with the sclerotica. Thus introduced, it is to be pushed on slowly, but steadily, without the least intermission, and in a straight direction, with its blade parallel to the iris, so as to pierce the cornea towards the inner angle of the eye, on the side opposite to that which it first entered, and till about one-third part of it is seen to emerge beyond the inner margin of the cornea. When the knife has reached so far, the punctuation is completed. The broad part of the blade is now between the cornea and the iris, and its cutting edge below the pupil, which of course is out of all danger of being wounded. As every degree of pressure must now be taken off the eyeball, the fingers, both of the operator and his assistant, are instantly to be removed from this part, and shifted to the eyelids. These are to be kept asunder by gently pressing them against the edges of the orbit; and the eye is to be left entirely to the guidance of the knife, by which, says Mr. Ware, it may be raised, depressed, or drawn to either side, as may be found necessary. The aqueous humour being now partly, if not entirely evacuated, and the cornea of course rendered flaccid, the edge of the blade is to be pressed slowly downward, till it has cut its way out, and separated a little more than half the cornea from the sclerotica, following the semicircular direction, marked out by the attachment of the one to the other. (*Ware.*)

In the eyes of some persons, the iris is so convex, that it is almost impossible to complete the section of the cornea, without entangling the iris under the edge of the knife, unless the cornea be gently rubbed downward with the finger; one of the most important directions, according to Mr. Ware, in Wenzel's whole book. However, it is alleged by Mr. Guthrie that the iris will not be disentangled unless something more be done, and this is to raise the eye, or to draw it, as it were, out from the orbit, whilst the cornea is pressed flat against the blade of the knife. (*On the Certainty, &c. of Extraction*, p. 23.)

If the edge of the knife should incline too much forward, and its direction be not altered, the incision in the cornea will be too small, and terminate almost opposite the pupil. In this case there will be great difficulty in extracting the cataract, and the cicatrix afterwards may obstruct sight. If, on the contrary, the edge of the instrument be inclined too much backward, and its direction be not changed, the incision will approach too near the part where the iris and sclerotica unite, and there will be great danger of wounding them. These accidents may be prevented by gently rolling the instrument between the fingers, until the blade takes the proper direction. (*Wenzel.*)

The late Mr. Ware had seen operators, through a fear of wounding the iris, introduce and bring out the instrument at a considerable distance before the union of the cornea and sclerotica; in consequence of which the incision from one side of the cornea to the other was made too small for the easy extraction of the cataract, although, from above downward, it was fully large enough for this purpose. Mr. Ware also sometimes observed, that though the punctuation of the cornea, from side to side, had been properly conducted, and its section afterwards, to all appearance, effectually completed; yet, on account of the frictions, employed to disengage the iris from the edge of the instrument, the knife, in cutting downward, was carried between the layers of the cornea, and, consequently, though the incision appeared, externally, to be of its proper size, internally it was much too small for the cataract to be easily extracted. In this case, the incision must be enlarged, by means of a pair of curved blunt-pointed scissors, which should be introduced at the part where the knife first entered the cornea. (*Ware.*)

Beer subdivides the first stage of this operation into four, each of which, he says, claims the utmost attention, if it be wished to make the incision in the cornea in every respect proper: the first is the introduction of the knife through the cornea into the anterior chamber; the second is directing the knife towards the place where its point is to be brought out again; the third is bringing out the point, and guiding the knife in continuing the incision in the cornea; and the fourth is the finishing of that incision. As Beer states, a completely well-made incision in the cornea, must, in the first place, be of sufficient size, to let the cataract escape from the eye without the slightest impediment; and it will be large enough, if care be taken to open one-half of the cornea near its edge. Secondly, It must be of a proper shape, its margin not being triangular, nor notched, but evenly rounded. In general, says Beer, no greater disadvantage can happen, than that of having too small an incision in the cornea; for even when the cataract is pressed out of such an opening, portions of it are always left behind, which afterwards cannot be extracted without trouble; and though the sight may be at the moment restored, it will be fortunate, if the eye be not afterwards spoiled by the effects of inflammation. When the incision is triangular, or notched, its edges cannot be put smoothly together so as to be healed by the first intention, which, however, is highly necessary, and the consequence is a white ugly scar, which is slowly produced with inflammation, and forms a greater or lesser permanent impediment to vision downwards, though the patient be capable of seeing the smallest objects, which are straight before him.

According to Beer, when the knife is to be introduced, its point should enter the cornea, about one-eighth of a line from its edge, and one-fourth of a line above its transverse diameter, directed obliquely towards the iris, with its edge turned downwards, by which means the point will pass immediately into the anterior chamber. As soon as it has arrived there, which is indicated partly by its bright extremity being seen within the space in question, and partly by the *tactus eruditus*, such a direction is to be given to it, that its point may project from the place of its entrance nearly in a direct line towards the intended place of its exit out of the cornea, but a little higher; while the posterior surface of the blade is to be conveyed across the anterior chamber exactly parallel to the iris. The knife is to be cautiously pushed on, neither too quickly, nor too slowly, with its point continually directed somewhat upwards above the part, where it is to pass out again, until the point arrives near the inner edge of the cornea; but, in the transverse passage of the knife, its edge should not be suffered either to go nearer to, or further from, the iris, as every turn of the blade backwards, or forwards, opens the upper angle of the wound, when the aqueous humour immediately escapes, and the iris not only falls close against the posterior surface of the blade, but, sometimes even under the edge, so as to throw the young operator into the greatest embarrassment. If the point of the knife has now been favourably brought out, the surgeon is to continue to push it on, without pressing it downwards, or making a sawing motion with it, until the last stage of the operation, viz. that in which the incision is finished. However, as soon as the point of the knife has passed out of the cornea, and reached the inner canthus, attention must be paid, first, to that part of the blade which is yet in the anterior chamber, so that the iris may not fall under its edge, and the knife may not take an erroneous direction. Secondly, To the point of the knife, which continually projects more and more, so that the inner canthus may not be wounded, which accident, though trivial in itself, would make the unprepared patient suddenly and involuntarily draw back his head. The only way of preventing this injury, says Beer, is regularly to incline the handle more backwards and downwards, in proportion as the point passes further out of the anterior chamber. Thirdly, At the period when the last piece of the cornea is to be cut, the knife should be pushed on very slowly, for otherwise the lens, and with it a part of the vitreous humour, may be discharged, as now the muscles of the eye are acting, and compressing this organ with the greatest force, and in old persons especially, the loose conjunctiva, after the cornea is cut through, comes against the knife, and is apt to be wounded. At the time when the operator finishes the incision in the cornea, the assistant is to let the upper eyelid cover the eye, and a few seconds are to be allowed for the patient to recover from his fright.

In the second stage of the operation, Beer directs the assistant again steadily to hold the patient's head in the same manner, as during the cutting of the cornea; but, the upper eyelid, he says, must be carefully and effectually raised, without touching the eyeball in the least, or letting the ends of the fingers project beyond the edge of the tarsus. The operator is to depress the lower eyelid with his forefinger, which is not to be removed away from the eye, but gently applied to the lower part of it with the intervention of the eyelid, by which means the cataract-lance, or capsule-needle, may be more readily and easily introduced under the flap of the cornea into the pupil, while the gentle pressure, and the projection of the cataract, thereby produced, considerably enlarge the pupil, and facilitate the proper division of the capsule. In order to complete the latter object, the surgeon introduces one of the sharp edges of the capsule-needle, with the point directed towards the inner canthus, between the cornea and the iris, the wound in the former of these membranes being opened as little as possible, lest the atmospheric air enter the eye; a circumstance of which Beer entertains great apprehension. After the capsule-needle has been cautiously passed to the inferior margin of the pupil, its lower sharp edge is to be applied to the capsule of the lens with its point directly upwards, and one of its flat surfaces towards the inner, and the other towards the outer canthus. The operator is now strictly to cut through the capsule, by making, at small distances from one another, repeated perpendicular strokes with the edge of the needle. Then the handle of the instrument is to be half turned round on its axis, and similar strokes are to be made with its edge in a somewhat oblique direction, by which means the anterior layer of the capsule will be cut into many squarish fragments; some of which, in the third stage of the operation, are taken out of the eye together with the cataract, and the risk of a secondary cataract of the anterior layer of the capsule is in a great measure removed. When the capsule-needle has done its business, it is to be withdrawn from the eye in the same position in which it was introduced, and the second stage of the operation is thus finished. (*Beer*, b. ii. p. 369.)

I believe no better instructions than the foregoing can be delivered, respecting the most advantageous method of dividing the capsule. They are infinitely better than those given by Wenzel and Ware. As soon as the point of the cornea-knife had arrived opposite the pupil, Wenzel used to incline it gently backward, and thus puncture the capsule.

For dividing the capsule after the division of the cornea, Wenzel and his father used to employ a flat needle, one-twelfth of an inch in diameter, having its cutting extremity a little incurvated. This needle, which they advised to be made of nealed gold, in order that its pliability may allow the operator to bend it in different directions, as occasion requires, is fixed in a handle, two inches and a half in length, and similar to that of the cornea-knife. At the other extremity of the same handle a small curette, or scoop, is fixed, made of nealed gold, which is of use for extracting the cataract.

The late Mr. Ware's method of opening the capsule will be hereafter noticed.

When the incision in the cornea has been completed, and the capsule effectually divided, the cataract, as Beer observes, advances into the pupil immediately behind the capsule-needle, and, if there be the least action in the eye itself, it is generally at once discharged. Under these very favourable circumstances, however, it sometimes happens, that a portion of the gelatinous or scabrous surface of the cataract is detached at the margin of the pupil, as the opaque body is passing out, and, therefore, in the second stage of the operation, Beer recommends having Daviel's scoop always ready, which is to be substituted for the capsule-needle, and employed for preventing the loose fragments from falling back into the posterior chamber in the following manner: — As soon as the operator remarks, that, in the passage of the cataract out of the pupil, a portion of it will be scraped off by the edge of that opening, he should introduce the scoop at the lower and outer edge of the cataract upwards, between the cornea and the iris, so as to be able to keep the part of the cataract, which is ready to break off, close up behind the rest of it, and bring the whole out of the eye.

But says Beer, when the third stage of the operation, viz. the removal of the cataract from the eye, cannot be so readily accomplished; a circumstance, not always owing to an imperfection in the incision in the cornea, or in the division of the capsule, but sometimes proceeding from a want of proper action in the eye itself; the operator, if he feels convinced that the fault does not lie in the first or second stage of the operation (in which case, it would be necessary to endeavour to rectify what is wrong), should assist in promoting the discharge of the cataract. There are two manners of doing this, and it is not a matter of indifference which is selected; for, the second should be adopted only when the first will not answer. Hence, says Beer, the operator like a skilful accoucheur, must first trust to the action of the organ itself, which he should in a certain degree excite, and not proceed immediately to the use of a scoop, hook, or forceps. The eye is to be suffered to turn quickly a few times upwards, and in general, during these movements, the surgeon will perceive, that the lower edge of the cataract advances further through the pupil, and, at length, slips out of the eye, without the aid of instruments. If, at this period, a portion of the cataract were found to be likely to break off, the employment of Daviel's scoop, in the way already explained, would be proper. On the other hand, if during the protracted movements of the eye upwards, this organ evince little energy of its own, the cataract will not enter the pupil, or scarcely do so, much less pass out of the eye, and the operator is under the necessity of resorting to manual assistance, and with the end of the finger, used for keeping the lower eyelid depressed, he is gently to press the lid against the lower part of the eyeball. Such pressure should be gradually increased until the greatest diameter of the cataract has passed into the pupil, at which moment, the pressure must not be discontinued, before the cataract is completely out of the eye, which object may be promoted by supporting the lower part of the lens with Daviel's scoop, and then the pressure is to be diminished in the same gradual way in which it has been previously augmented. Immediately the cataract is completely out of the eye, and the surgeon has paid due attention to the removal of any fragments left behind, the assistant is to let the upper eyelid descend, the patient is to be desired to keep both his eyes shut and perfectly still, and his head and eyes are to be covered with a clean white piece of linen, so that the effect of the light may be moderated.

When the patient has recovered from the alarm, which, according to Beer, the passage of the cataract outwards, especially when it is large and firm, always produces in a greater or lesser degree, he is to be placed with his back towards the window, and the linen is to be raised a little from the eye, which is to be very slowly opened, while the other eye, which has not been operated upon, is to be kept well covered. Beer says, that the patient should then be shown some objects, not of a shining or very bright description, at different distances; and, if he is able to see them plainly, the surgeon may proceed to apply the dressings without delay.

Beer confesses, that, if possible, it would be better to dispense altogether with making any trials of the power of the eye, which has just been operated upon, because such attempts must tend to increase the subsequent inflammation in the organ; yet he is of opinion, that these trials of the eyesight are necessary after extraction of the cataract. First, Because the capability of seeing immediately is a thing always expected by the patient and his friends, and leaving them in ignorance on this point would keep up an anxiety likely to have a bad effect in rendering the ophthalmy more severe. Secondly, Beer urges, as a stronger motive for the custom, the circumstance of the patient seeing, when his eye is first opened, all, even the smallest objects, though he suddenly loses the faculty of distinguishing them at all, or sees them very obscurely; and, now, if he be half turned with his face towards the window, one will find in the pupil, which directly after the passage of the cataract was perfectly clear, some soft or firm fragments of the lens, which are first dislodged from within the capsule by the variations in the eye, produced by the inspection of different objects at different distances, and which, without these trials of vision, would be long in being loosened by the aqueous humour, and might form a secondary lenticular cataract; which will not now be the case, as the surgeon can and ought at once to remove them. (*Lehre von den Augenkr.* b. ii. p. 373.)

The preceding mode of operating, as Beer observes, will not answer for every case of cataract, adapted to extraction; the plan sometimes requires to be modified according to circumstances. Thus, according to the same writer, when the eye is very prominent, and particularly when at the same time the fissure of the eyelids is extremely narrow, the incision in the cornea must not be made horizontally, but obliquely outwards; for otherwise the edge of the lower eyelid will retard the healing of the wound, and an ugly cicatrix, more or less injurious to the eyesight, be the consequence.

When the cataract is of middling consistence, neither very hard, nor soft, Beer assures us, that the attempt ought to be made to extract the cataract and the capsule together, (*Methode den grauen Staar Sammt der Kapsel auszuziehen*, &c. Wein, 1799.) In such a case, he says, the experiment will mostly succeed, if properly conducted, and, if it should not, it causes not the slightest detriment to the eye, nor the least obstacle to the effectual completion of the operation. The capsule-needle is to be introduced into the pupil, as in the second stage of the operation, and its point is then to be slowly pushed, as far as its greatest diameter; into the centre of the lens, so that one surface of the needle may be upwards, the other downwards, one of its cutting edges turned towards the inner canthus, the other towards the outer one. And now the needle, with the impaled cataract is to have sudden, but short perpendicular jerks communicated to it, by which means, the upper and lower connections of the capsule with the neighbouring textures will be in part loosened. The needle is next to be suddenly rotated, without withdrawing it from the cataract, so that one of its flat surfaces may face the inner canthus, the other, the outer one; and one of its edges may be turned upwards, the other downwards; and then the short sudden jerks of the needle in the horizontal direction may be repeated for the purpose of breaking, as much as possible, the lateral connections of the capsule. Lastly, The capsule-needle is to be quickly withdrawn from the eye, when it is mostly followed by the lens and the capsule, or the cataract comes away fixed on the point of the instrument, at which moment the pupil becomes perfectly clear and black. When the cataract does not follow the removal of the needle, the surgeon is to proceed with the usual cautions to the third stage of the operation. Great as the advantage would always be of extracting the cataract together with its capsule, it is plain, that the attempt is not practicable when the case is a hard lenticular cataract; because the capsule needle cannot be effectually introduced into the body of such a lens, situated upon the yielding vitreous humour. Nor would the plan answer, if the cataract were very soft, as the movements of the needle in it could have no effect in breaking the connections of the capsule. Mr. Lawrence has often expressed to me his decided opinion, that the foregoing method will rarely succeed, and ought not to be attempted; which is also Mr. Guthrie's judgment. (*Operative Surgery of the Eye*, p. 308.)

In the case described by Beer under the name of *encysted cataract*, the capsule must not be opened; but after the cornea has been divided, if the cataract does not escape of itself at this moment from the eye, the operator must immediately introduce the small cataract-tenaculum, with its point turned downwards, between the cornea and the iris, into the pupil. The cataract should then be firmly taken hold of with the hook, and slowly and steadily drawn out of the eye with its thick, tough capsule. Beer says, that extraction should be performed in the same way in the dry siliquose capsulo-lenticular cataract of children and adults, except that in all these cases, a fine, elastic, sharp, silver, or golden spatula, fixed at the lower part of Daviel's curette or scoop, should be ready at hand to assist in separating the cataract from the vitreous humour, immediately the opaque substance is disposed to pass out of the eye. Also in the completely fluid cataract, when the capsule is partially opaque and thickened, a circumstance easily known by appearances, the same mode of extraction must be attempted. But, if the hook should tear its way out, and the capsule empty itself, the extraction must be performed altogether with the forceps. The latter instrument is to be cautiously introduced, in the same manner as the capsule-needle, into the pupil, one of the largest and thickest portions of the capsule is then to be taken hold of, and suddenly drawn out towards the opposite side, by which means generally the whole anterior layer, and sometimes also the posterior layer of the capsule will be detached, and the pupil immediately cleared. On the contrary, in what Beer has called the *bar-cataract*, which, he says, is seldom fit for an operation, as soon as the cornea has been opened, the bar must first be separated, by means of the capsule-needle, from the uvea, in whatever way is found most practicable, and then it is to be extracted with the small cataract-tenaculum, or teeth forceps: when this has been done, the cataract itself must be taken out of the eye in the same manner as the encysted cataract. (B. ii. p. 377.)

When extraction has been completed, the next object is to dress the eye: while the patient turns this upwards, the lower eyelid is to be drawn downwards with the forefinger, and steadily held so, until the patient has shut his eye as much as possible.

Mr. Ware found, that a dossil of lint, steeped in plain water, or brandy and water, and covered with the spermaceti or saturnine cerate, and removed once every day, is the most easy and convenient dressing that can be applied after the operation. The cerate over the lint prevents the latter, when impregnated with the discharge, from becoming stiff, and irritating the lids. Mr. Ware thought the mode of applying the compress and bandage over the eye, a circumstance of no small importance; because, if too loose, the dressings are very apt to slip off, and, consequently, to press unequally and injuriously on the eye; and if too tight, the undue pressure will excite pain and inflammation, and even force out some of the vitreous humour. Mr. Ware's compress is made of soft linen, folded, two or three times, wide enough to cover both eyes, and sufficiently long to extend from the upper part of the forehead to the lower part of the nose. This he pins at the top of the patient's nightcap; and its lower part, which is divided in the middle, to allow the nose to come through it, he lays loosely over the eyes. The bandage, also made of old linen, and as broad as six fingers, he carries round the head over the compress, and pins to the side of the nightcap moderately tight. A slip of linen is afterwards carried under the chin, and pinned at each end to the side of the bandage, so as to prevent it from slipping upwards. (*Ware.*) Mr. Guthrie recommends an elastic network nightcap, which fits the head closely, and a piece of roller to be fastened by its middle to the centre of the cap behind. "A small piece of lint, on which some ung. cetacei has been spread, is to be applied over the closed eyelids, a compress of fine linen is to be placed over it, and another over the opposite eye, when each end of the roller is to be brought forwards, made to secure the compress of its own side, and then passed over to the other." (*Operative Surgery of the Eye*, p. 314.)

Beer recommends the patient to lie upon his back, with his head not too low, and in a chamber which is not too light, and to remain in this way at least until the wound in the cornea is closed. As during the first two days after the operation, the doubled piece of linen, which Beer places over the eye, is repeatedly wet through with the discharged aqueous humour, it is to be changed several times a day. He also enjoins the observance of every thing which has been already pointed out as proper after depression and reclination; and, in particular, while the wound in the cornea is not firmly healed, and the eye cannot be kept open, the patient must refrain from taking snuff and smoking tobacco. According to the same author, no thoughts should be entertained of opening the eye again, till two or three days after the discharge of the aqueous humour has completely ceased; a circumstance always indicated by slight prickings in the eye itself, by a burning, though not very severe, pain, attending the escape of that fluid from the inner canthus, and in irritable, nervous, debilitated subjects, even by the sensation of transient luminous appearances. Therefore, Beer says, the eye should seldom be opened before the fifth or sixth day. When this is first done, the light should be very moderate, and the patient placed with his back towards it, all unnecessary lateral light being kept from the eye by the linen attached to the forehead, while the daily trials of the newly recovered powers of the eye should be made with the utmost caution. On the 8th, 9th, or, at latest, on the 10th day, Beer recommends leaving the eye open, but screened above by a green eye-shade, in a half-darkened chamber; and the patient is afterwards to be treated, until his eye is perfectly well, according to the rules already laid down as proper to be observed after couching. And, especially when the patient has had cataracts in both eyes, Beer thinks it as well to apprize him, in order to prevent unnecessary alarm, that, upon first going out into the open air, particularly in the evening, he will be for some moments almost blinded, and then begin to see again, but every object will now appear covered with a white, shining circle, which at length goes off; though, in the open air, it will sometimes continue for several days. (B. ii. p. 380.)

A few hours after the operation, Mr. Guthrie always bleeds the patient, whether pain come on, or not; and if it continue, or afterwards take place, he repeats the evacuation. In another few hours, if no amendment occur, he has recourse even to a third bleeding. For the first twenty-four hours, he does not wish the patient to be disturbed with purgative medicines, so as to produce any risk of the edges of the cornea being displaced; but, after this period, he exhibits saline aperients, and, when much inflammation is expected, he prescribes calomel, combined with opiate confection; and, if the inflammation continue, he gives two grains of calomel with $\frac{1}{4}$ or $\frac{1}{2}$ of a grain of opium, three or four times in the course of twenty-four hours, so as to affect the system, and prevent the bad consequences of the inflammation of the iris and internal parts of the eye. (See *Guthrie's Operative Surgery of the Eye*, pp. 315, 316.)

On the morning after the operation, Mr. Guthrie gently frees the eyelid from any moisture, and replaces the light compress and bandage. "The occurrence of a discharge of tears, and particularly hot ones, marks some degree of inflammation, which must be immediately arrested, especially if the eyelid swells. This is only to be done by the abstraction of blood, in the first instance, from the arm, and locally afterwards by cupping, or leeches."

The late Mr. Ware published an inquiry into the causes preventing the success of extraction.

The first, which he considers, is making the incision through the cornea too small. In this circumstance, a degree of violence will be required to bring the cataract through the wound; and, if the cataract be not altered in its figure, the wound will be forcibly dilated, and the edge of the iris compressed between the cornea and the cataract. In this way, either some of its fibres may be ruptured, or it may be otherwise so much injured as to excite a considerable degree of inflammation, and even induce, in the end, a closure of the pupil.

This accident may arise from the operator's cutting the cornea, without being able to see exactly the position of this membrane, in consequence of the eye having turned inward, owing to its not being properly fixed. The fault may also proceed from the incision having been begun below the transverse diameter of the cornea. In this manner, nine-sixteenths, or rather more than half of the circumference of this membrane, will not be divided; which extent the incision ought always to occupy, in order to allow the cataract to be extracted with facility.

When however the cornea is remarkably flat, and the iris projects unusually forward in the anterior chamber, Mr. Ware recommends including only one third of the cornea in the first incision, and afterwards enlarging the aperture, on the outer side, by means of curved scissors.

Taking care to fix the eye in Mr. Ware's way, is represented by this author as being of great consequence in hindering the wound in the cornea from being made too small.

Whenever the wound in the cornea is made too small, it should always be enlarged before proceeding further in the operation; and, according to Mr. Ware, this can be best accomplished with a pair of curved blunt-pointed scissors, on the outer side of the cornea, where the knife has made its entrance.

For doing this, Beer recommends the use of Daviel's scissors, which are to be introduced with their concavity towards the operator, and their point directed towards the pupil. Beer also introduces the point of the inner blade into the middle of the wound of the cornea, under the flap already made, and passes it somewhat higher than the place to which it is necessary to enlarge the incision. Then he first conveys the instrument to the inner or outer angle of the wound, where the dilatation is to be made, keeping the blade, which is within the cornea, not parallel to the iris, but in an oblique position with respect to it, for otherwise the best scissors will fail to make a clear division. The scissors also must not be opened more than is absolutely necessary, and they should be very quickly shut, and in such a manner, that the outer blade ought only to move towards that within the cornea, lest the eye suffer injury. Beer says that it is hardly ever necessary to enlarge the incision in the cornea at both its angles; and, in these cases, he confesses, that all idea of shaping the wound altogether as it ought to be, must be renounced. (*Lehre von den Augenkr.* b. ii. p. 382.) As already explained, Jaeger uses a double knife, with which it is alleged the incision in the cornea may always be made of due size. (See *Loudon's Short Inquiry, &c.* 1826.)

Wounding the iris with the cornea-knife, the effect of which injury seems to Mr. Guthrie to have been much exaggerated, is the second accident which Mr. Ware considers. The principal cause seems to him to be a discharge of the aqueous humour, before the knife has passed through the cornea low enough to hinder the lower part of the iris, which forms the inferior rim of the pupil, from getting beneath the edge of the instrument. According to Mr. Ware, the escape of the aqueous humour may be owing to some inaccuracy in the shape of the knife, or unsteadiness in introducing it. The falling of the lower part of the iris under the edge of the knife, he believes, cannot always be prevented, by the utmost skill or precaution of the operator. Happily, however, says he, we have been taught, that the iris may be reinstated, after it has been thus displaced, and without suffering any injury, by making gentle frictions on the cornea with the point of the finger. With these frictions, as I have already mentioned, Mr. Guthrie adopts the expedient of drawing forwards the eye from the orbit, and pressing the cornea flat upon the blade, as an essential thing to make the iris recede.

By unsteadiness in passing the knife, Mr. Ware means, that the knife may not only be suffered to make a punctuation through this tunic, but, that its edge may, at the same time, be unintentionally pressed downward, so as to make an incision likewise; in consequence of which downward motion of the knife, an aperture must unavoidably be left in the cornea, through which the aqueous humour will escape. If the cornea-knife increase through its whole length, both in width and thickness, and if it be merely pushed through the cornea, no space will be left, through which any fluid can escape.

According to Beer, the escape of the aqueous humour, as the knife passes across the anterior chamber, may happen with or without any fault on the part of the operator, and the iris fall not merely against the posterior surface of the knife, but even project under its edge, and over its back. When this happens, Beer joins Ware in recommending the end of the middle finger, situated at the inner canthus, to be gently pressed without delay upon that part of the cornea which is in front of the knife; and, at the moment when this is done, the iris will recede from the edge of the instrument; and the operator, by being very quick, may proceed again without any risk of injuring that part of the eye. But, if the iris should be found to project again above and below the knife immediately the point of the finger is removed from the cornea, such removal should not be made, and the knife be boldly pushed on until its point pierces the other side of the cornea; or, if the point has already passed some way out of the cornea towards the inner canthus, the blade is to be pushed on so far, that no protrusion of the iris is possible. For, says Beer, while the finger continues to make gentle pressure upon the cornea, the iris will not fall under the knife. Should the eye chance to withdraw itself from the knife, after this has penetrated the anterior chamber, — a circumstance which may easily happen in restless timid patients,—the greater part or the whole of the aqueous humour is immediately discharged, and the iris comes in contact with the empty cornea. In this case, Beer says, that the operator should find out the wound with another knife; and with a wriggling motion of the instrument, conduct it between the iris and the cornea, twisting and turning the point about until it has successfully passed beyond the external, then beyond the inner pupillary margin of the iris, and has finally come out of the cornea again. Now the incision in the cornea may be properly finished, in doing which, it is always necessary to keep the middle finger applied to this membrane, in consequence of the disposition of the iris to fall against the knife. Beer mentions it as a curious fact, that most of the patients, who are restless and unmanageable at the first introduction of the knife, and who themselves cause the disagreeable occurrence now spoken of, are, on the contrary, very quiet during the foregoing manœuvres. (*Lehre von den Augenkr.* b. ii. p. 381.)

The third accident, noticed by Mr. Ware, is the escape of the vitreous humour. The common cause of this occurrence is the undue application of pressure. It may take place, either when the incision is made through the cornea, or at the time of extracting the cataract. Some eyes are subject to spasm, which renders them much more liable to this accident. To prevent it, Mr. Ware recommends every kind and degree of pressure to be taken from the eye, before the knife has completely cut its way through the cornea. And, as soon as the knife has proceeded sufficiently low to secure the iris from being wounded, the operator should not only take heed, that his own fingers do not touch the eye, but should also direct the assistant, who supports the upper lid, to remove his fingers entirely from this part. The assistant seldom need make any pressure on the globe of the eye; however, when there is room for one of his fingers to be placed on the inner and upper part of the globe, without interfering with those of the operator, the method may be followed, in order to make the eye still more fixed. But immediately the *punctuation* of the cornea is completed, the assistant's finger should always be entirely removed, both from the eyelids and eye itself.

Notwithstanding the upper lid is left thus free, there will be sufficient space between it and the lower lid, to allow the progress of the knife to be seen; and, in finishing the wound, the operator should depress the lower lid with great gentleness.

With Jaeger's double knife, the risks, arising from a very early escape of the aqueous humour, are said to be avoided.

The vitreous humour may also be lost, in consequence of opening the capsule of the lens nearer the circumference than the centre of the pupil. As the crystalline is both thinner and softer at that part, the instrument will be liable to pass through both sides of the capsule, and enter the vitreous humour. This humour, having no longer any barrier to its escape, is liable to be forced out by the action of the eyelids alone; and, when pressure is afterwards made to bring the cataract through, a much greater quantity will be lost; and the cataract, instead of coming forward, will recede from the pupil. The only way to extract it now, is, by letting the upper lid be gently raised by an assistant (a rare instance, in which this is necessary after cutting the cornea), while the operator, either with the forefinger of the left hand, or with the blunt end of the curette, applied beneath the incision in the cornea, prevents the cataract from sinking further. Then, with his right hand, let him introduce a hook under the flap of the cornea, and with its point carefully entangle the cataract, and bring it away.

To prevent, however, such difficulties, Mr. Ware never attempted to puncture the capsule, until the whole pupil was in view. He was in the habit of opening the capsule with a gold-pointed needle, arched towards its extremity. Wenzel's needle, for this purpose, was flat in its extremity; Mr. Ware's, pointed; and this is their only difference. The latter introduced his instrument under the flap of the cornea, with its arched part uppermost, until its point was on a level with the centre of the pupil. The end of the instrument was then turned inward, and gently rubbed on the capsule of the crystalline until it pierced it. In a few instances, Mr. Ware found the capsule so tough, that the point of the gold needle would not enter it, and he was obliged to use a sharp steel instrument, of the same shape as that with a gold point. As already explained, Beer was much bolder with the capsule than Ware, and there can be little doubt, that both his capsule-needle and his mode of using it are better than those of Wenzel and Ware.

The vitreous humour may also be lost, at the time of extracting the cataract, and the usual cause is an undue application of pressure. All violent pressure is quite unnecessary for forcing out the cataract, when the wound in the cornea is sufficiently large. When the wound is too small, it should be enlarged as above directed. If pressure be continued at all after the cataract has been extracted, the capsule of the vitreous humour will certainly be ruptured, and some of this part of the eye protrude. Pressure may even rupture the capsule of the vitreous humour, before the cataract has been brought through the incision in the cornea; the same consequences will ensue, and the same practice be necessary, as in the case in which the operator has unskilfully opened the capsule of the vitreous humour with the needle, in attempting to open that of the lens.

In taking away fragments of opaque matter from the pupil by means of the curette, great care is requisite to avoid wounding the posterior part of the capsule of the crystalline lens with the end of the instrument, so as to open a way for the escape of the vitreous humour.

The vitreous humour may, indeed, be forced out, after the extraction of the cataract, merely by a spasmodic action of the eyelids. On this subject, Mr. Ware, after hinting his suspicion, that, in a case of this kind, which he saw, the assistant's keeping up the lid contributed to the event, repeats his advice, "that after the cornea has been cut, the upper eyelid should be raised solely by the fingers of the left hand of the operator."

Mr. Ware seems to think, that more evil has resulted from the operator being deterred by the readiness with which the vitreous humour continues to start out, from ascertaining that all the fragments of the cataract are removed, and that the whole of the iris has resumed its position, than from the mere loss of the vitreous humour, which is quickly regenerated.

When a portion of the vitreous humour protrudes, Beer thinks, that the safest practice is not to meddle with it, though he owns, that in this circumstance, the wound heals slowly, and is always followed by a more or less perceptible whitish scar, the pupil being generally drawn towards it, and deformed, while the iris and the partly emptied membrana hyaloidea become adherent to the edges of the incision in the cornea. But, says Beer, the eyesight will be but little or not at all impaired, notwithstanding one-eighth or one-fourth of the vitreous humour may be lost. However, he observes, that when one-third or half of it has escaped, a good degree of vision afterwards cannot be expected; and when more than half has been lost, the operation will have a still less successful result. He states also, that when two-thirds have been lost, though the eye may recover its natural form, the pupillary edge of the iris will remain contracted round the empty, light-grey membrana hyaloidea, which projects into the anterior chamber, consequently, the pupil will be closed, and that state of the iris ensue, which is aptly termed a *sinking of the pupil, subsidentia pupillæ*, or *synizesis*. Some modern surgeons conceive that the mischievous effects of the loss of the vitreous humour have been overrated. Thus, one very experienced practitioner declares, that, at least two-thirds of it may escape, and yet vision not be at all injured by the accident. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 137.) And another, who, pronounces the loss of the vitreous humour to be a surgical bugbear, has lately published the following statement:—"I once saw the lens violently forced out, and the vitreous humour with it, and it appeared to me, as well as to the operator, that the whole of it was discharged: nevertheless the patient recovered a faint degree of sight. This case taught me how much might be lost, without the eye being destroyed, and I soon learned, that a great part might be lost without any inconvenience." I apprehend that it is *better to lose a fourth or fifth part* than *an eighth*, although it is still *better to lose none*. (*Guthrie on the Certainty, &c. of Extraction*, p. 33.) In the latter observation I fully agree; but the reasoning and statements immediately before it are to me by no means convincing, unless it be proved, that "if a very small portion of the vitreous humour be lost, it is usually followed by severe inflammation: if a larger quantity is lost, there is usually less."

Mr. Ware notices the accident of extracting only a part of the cataract, and leaving the remainder behind. He is an advocate for removing all opaque substances from the pupil, except an extreme degree of irritability, to which some eyes are subject, should render the introduction of every sort of instrument, after the cataract has been extracted, difficult and dangerous. Mr. Ware usually removed opaque portions of the cataract by means of a curette: and, occasionally, when the opaque substance was large, and adherent to the capsule, he was obliged to extract it with small forceps. Before finishing the operation, he approves of always rubbing the end of the finger gently on the fore part of the eye, over the eyelids; which proceeding tends to bring into view any opaque matter, which may previously lie behind the iris. Mr. Ware relates a case, proving, that such opacities, as cannot be removed in the operation, are capable of being absorbed.

When, notwithstanding the observance of the directions laid down by Beer, as explained in the previous columns, some of the pultaceous, or scabrous surface of the cataract is detached, and continues behind in the posterior chamber, Beer says, that it ought to be immediately removed, lest the patient be left with a secondary lenticular cataract, which, he observes, is not always so certain of being dissolved and absorbed, as some imagine. The fragments may be removed in two ways; and, first, the experiment of rubbing the upper eyelid over the eye should be made; because it not unfrequently brings the remains, especially when they are gelatinous, completely through the pupil, and out of the incision in the cornea. But, if such manœuvre should not be effectual, Beer recommends cautiously introducing Daviel's curette to the outer pupillary edge of the iris, with its concavity towards the inner surface of the flap of the cornea, without raising this flap unnecessarily high, and then the operator is to endeavour to scoop out at once as much of the opaque matter as he can, and bring it to the inner surface of the cornea. He says, that it will rarely be necessary frequently to repeat the introduction of the curette. (B. ii. p. 387.)

According to Mr. Ware, an opacity of the capsule can be the only reason for removing it. The anterior part, he says, can alone become the object of the operator's attention: its posterior part is necessarily hidden, while the cataract remains in the eye, and afterwards, if discovered to be opaque, it is so closely connected with the capsule of the vitreous humour, that Ware believes it cannot be removed by any instrument, without hazarding a destructive effusion of this humour. When however, the opaque lens is accompanied with an opacity in the front part of the capsule, he recommended the following plan: — After cutting the cornea, as usual, a fine-pointed instrument, somewhat smaller in size than a round couching-needle, and a little bent towards the point, should be introduced under the flap of the cornea, with its bent part upward, until its point is parallel with the aperture of the pupil. The point should then be turned toward the opaque capsule, which is to be punctured by it, in a circular direction, as near to the rim of the pupil as the instrument can be applied, without hurting the iris. Sometimes, the part included within the punctures may be extracted on the point of the instrument; and, if this cannot be done, it should be removed with a small pair of forceps. The lens, whether opaque, or transparent, should next be extracted, by making a slight pressure with the curette, either above, or below, the circumference of the cornea.

On the preceding subject, Beer remarks, that when none of the lens itself is left behind, but there is a slight degree of opacity in the anterior layer of the capsule, easily distinguishable from the cut flakes, and producing the least obstacle to vision, the opaque membrane should be taken away with the forceps, in the manner described in the preceding pages; for, otherwise, a secondary capsular cataract will follow, which will become of a snow-white colour; and if only a trivial degree of iritis take place after the operation, it will become adherent to the iris, and the pupil be contracted and disfigured. (B. ii. p. 388.)

Beer does not agree with Ware in condemning all attempts to remove the posterior layer of the capsule, when found opaque, after the extraction of the lens. The case, he says, is indicated by the light-grey speckled appearance of the whole pupil, and by the patient seeing nothing at all, or objects only indistinctly in a thick mist. Beer advises a cataract-tenaculum to be passed into the pupil, in the same way as the capsule-needle is introduced in the second stage of extraction, directing its point downwards as it enters, and upwards when it is brought out again. After it has entered the pupil, it is to be made to divide and annihilate, by repeated turns of the tenaculum, the back layer of the capsule, and also the membrana hyaloidea, directly behind it, which, in such a case, is always adherent and opaque. Of these membranes a considerable part, closely wound round the hook, may be taken out of the eye, though never without some slight loss of the virtreous humour. In cases of this kind, the patient ought to be informed, that though his sight will be restored, a part of the cataract must be left, and will be visible behind the pupil, particularly when it is dilated; for, otherwise, suspicions may arise, that the operation has been badly done, and a relapse apprehended. (B. ii. p. 388.)

The late Mr. Ware published some remarks on the bad consequences of allowing foreign bodies of any kind, after the operation, to press unequally on the globe of the eye; comprehending, under this head, the intervention of the edge of the lower eyelid between the sides of the divided cornea; the inversion of the edge of the lower eyelid; and the lodgment of one or more loose eyelashes on the globe of the eye.

To prevent the first accident, every operator, before applying the dressings, should carefully depress the lower eyelid; and before he suffers it to rise again, should take care, that the flap of the cornea be accurately adjusted in its proper position; and, that the upper lid be dropped, so as completely to cover it. After this, the eyelid should not be opened again, for three or four days, that is, until there is a good reason to suppose the wound in the cornea closed.

The inversion of the lower eyelid is hurtful, in consequence of its making the eyelashes rub against the eye. These should be extracted the day before the operation. For the mode of effecting a permanent cure, see *Trichiasis.*

Besides the danger, to which the eye is exposed from the inversion of the edge of the lid, the eye may receive injury from the improper position of the eyelashes alone; one or more of which during the operation, may happen to bend inwards; or, becoming loose, may afterwards insinuate themselves between the inside of the lid and the eye. An eyelash bent inward should be rectified; if broken off and loose, it should be removed.

Lastly, Mr. Ware considers prematurely exposing the eye to a strong light. He censures the plan of opening the eyelids within the first two or three days after the operation; because the stimulus of the light increases the ophthalmy, and the method is apt to disturb the wound in the cornea before it is closed. Mr. Ware, however, wishes it not to be inferred, that he is an advocate for long confinement after the operation. His mode is to keep the patient wholly in bed, and to direct him to move his head as little as possible, for the first three days after the operation. During this time, a dossil of wet lint is kept on his eyes, covered with a saturnine plaster, compress, and bandage as already described. The dressing is renewed once every day, and the outsides of the eyelids washed with warm water in winter, and cold in summer. At each time of dressing, the skin of the lower lid is drawn gently down, to prevent any tendency to an inversion. Animal food is prohibited, and the patient enjoined not to talk much. On the fourth day, he is permitted to sit up for two or three hours; and if he has had no stool since the operation, a mild opening medicine is now administered. On the fifth, the time of his getting up is lengthened; and, presuming that the wound in the cornea is now closed, Mr. Ware usually examines the state of the eye. After this, no dressings need be applied in the daytime, care being taken to defend it from a strong light, by a pasteboard hood or shade, and by darkening the room, so that no inconvenience is felt. The patient may now also look, for a short time, at large objects. The following part of the treatment need interfere very little with the wishes of the patient, unless unexpected accidents occur. (*Ware.*)

As Beer observes, if the patient be very restless, make frequent attempts to open his eyes in the least, and partly lie upon the eye, or if in changing the compresses the greatest caution be not used, the eye will perhaps be roughly pressed upon, and the iris protrude between the displaced and half-opened edges of the incision in the cornea, to which it will become adherent during a slow and seldom very violent inflammation. From the moment, when the iris thus interposes itself between the sides of the wound, the aqueous humour begins to collect, and at length pushes the iris considerably forwards. In this case, Beer recommends carefully opening the eye in a very moderate light, and adopting the expedients formerly mentioned, for the purpose of making the iris recede. The dressings should be re-applied, and the eye kept closed and very quiet for at least eight or ten days, so as to hinder a recurrence of this disagreeable accident. But, if the iris should be already adherent to the edges of the wound in the cornea, the eye incapable of bearing light, and the aqueous humour more or less accumulated in the anterior chamber, Beer says, every thing must be left to time, while the eye is kept lightly covered for about a fortnight, and the existing inflammation properly treated. Then, if the protrusion, or staphyloma of the iris should not be diminished by the means calculated for lessening the inflammation, caustic or the knife must be employed. (*Beer*, b. ii. p. 391.) The same causes, which have been above specified, as conducive to a protrusion of the iris, may also produce a discharge of the vitreous humour.

The following observations by Beer are interesting:—When the dressings have been unskilfully applied; when the incision of the cornea has been made horizontally upon a large prominent eye; when the fissure of the eyelids is exceedingly narrow, or the patient is restless a proper cicatrisasion of the wound in the cornea may not follow. Though the aqueous humour may collect in the anterior chamber, the partially united lamella of the cornea may be incapable of duly resisting the distention of that fluid, and consequently protrude in the form of a light-grey, semi-transparent, oval vesicle, extending nearly the whole length of the wound in the cornea, and being most prominent in the centre. The patient complains of an annoying sense of pressure in the eye, as in cases of protrusion of the iris; but the discharge of the aqueous humour has completely stopped, and therefore the anterior chamber presents its natural appearance, and the pupil its regular round shape, though the edges of the wound in the cornea are whitish and swollen. This case was formerly regarded as a prolapsus of the membrane of the aqueous humour; but, Beer considers it as a sort of hernia of the cornea, termed *ceratocele*. Merely puncturing, or cutting away the cyst is of no service; for, though the aqueous humour immediately flows out, the wound soon closes again, and the tumour re-appears, attended also with some risk of the iris falling into the cyst, and becoming adherent to it. Effectual relief cannot be obtained, unless the tumour be removed with Daviel's scissors, as close as possible to the wound; the dressings skilfully arranged: and the eye kept closed and quiet for eight days, or a fortnight. In such a case, a whitish scar is always permanently left. (*Beer*, b. ii. p. 393.)

Beer observes, that when the pupil contracts very considerably after the incision in the cornea has been made, and the cataract at the same time remains at some distance from the uvea, too small an opening has generally been formed, and it ought to be enlarged. But if the cataract cannot be forced through the pupil, without making pressure on the lower part of the eyeball, and the closure of the pupil should still continue, the circumstance proceeds from the loss of the aqueous humour, and the second stage of extraction must be deferred a little while, until the pupil dilates again, and the operation must then be finished in a very moderate light. (Also *Guthrie's Operative Surgery of the Eye*, p. 305.)

When, in the second stage of the operation, the anterior layer of the capsule has been properly divided, and yet the cataract will not pass into the pupil, though the eye itself acts with energy. Beer says, that it is indispensably necessary to make pressure upon the lower part of the eyeball, as already advised, and to continue it, either until the cataract with its lowermost edge effectually projects through the pupil and out of the eye, or until it is moved so far directly upwards (without entering the pupil) that its lower margin is brought into view, and quite a black semilunar interspace is seen between it and the inferior pupillary edge of the iris. At this moment the operator without increasing the pressure of the finger on the eyeball, lest the vitreous humour burst and a great part of it be lost, and without lessening the pressure, lest the cataract sink back into the eye, should introduce Daviel's curette into the above interspace, with its hollow surface applied against the back surface of the cataract, which is to be gently pushed out of the eye. In doing this, Beer owns that a small part of the vitreous humour is almost always lost; but the quantity is not at all comparable to what is lost, when the hyaloid membrane gives way before Daviel's curette is introduced, which can then only be passed into the eye through the protruded vitreous humour for the purpose of pushing out the cataract.

Beer notices the occasional protrusion of the iris, in the third stage of the operation, more or less between the edges of the incision in the cornea, immediately after the exit of the cataract. Here, says Beer, the iris should be reduced without the least delay; and the pupil, which is completely oval, made round again; a thing, which the operator may easily perform by applying his hand flat upon the patient's forehead, letting the latter shut his eye, rubbing the upper eyelid quickly, yet gently, with the thumb, and then suddenly opening the eye, by which means a moderate light will at once strike it, and produce an expansion of the iris.

In all patients, who have been operated upon for cataracts, the edges of the eyelids become glued together with mucus on the first night after the operation: yet, according to Beer, in individuals particularly subject to copious secretions of mucus, it is not unusual for the puncta lachrymalia and lachrymal ducts to be blocked up with thickened mucus, whereby the tears are prevented from duly passing down into the nose, so that from time to time they are discharged from the inner angle of the eye, and collect under the eyelids. In this case, the patient soon begins to complain of a violent, continual, and increasing sense of pressure on the eye, and the upper eyelid swells, unattended with any redness. Irritable persons also experience a stupifying dull headach. These inconveniences may be immediately removed by clearing away the mucus with a little lukewarm milk from the inner canthus, and letting a stream of clean water fall over the cheek. Care must also be taken to hinder a recurrence of the circumstance, and to remove it, if it should happen.

The inflammation, consequent to extraction, chiefly affects the iris and neighbouring textures. Beer refers its origin principally to the entrance of air into the interior of the eye; which, owing to the size of the wound, he says, is not entirely to be prevented. But another cause is the introduction of different instruments into the eye, and hence, the inflammation is generally severe, when it has been necessary to remove fragments of the cataract with Daviel's curette, or to take away the capsule with forceps, or destroy it with the tenaculum-needle. However, Beer is of opinion, that a surgeon, who knows how to operate well in every mode, will not find the inflammation, under these circumstances, more violent after extraction, than other methods, and therefore he thinks, that when no considerable impediment exists, it should be preferred. Beer, who considers extraction as a radical mode of removing a cataract, thinks that when there are no great and insurmountable obstacles to its performance, and the operator can execute it as well as all other methods, and with the requisite skill, it ought to be preferred. But, when he is deficient in skill, he is himself the greatest impediment to the success of the operation. The particular cases, in which the methods of depression and reclination are indicated, have been already specified, and in these, of course, extraction is not advantageous. (*Beer*, b. ii. p. 396.)

After extraction, the loss of the lens must be supplied by proper spectacles, which should not however be fitted to the eyes for several weeks, after the cure has been accomplished, in order to let the eye recover first as much power as possible, without artificial aid. The power of adjustment will necessarily be lost, and two pairs of spectacles be required; one for near, the other, for distant objects. Young persons often recover good sight, and in one instance, Mr. Guthrie has known the lens to be reproduced. (*On the Certainty, &c. of Extraction*, p. 43.)

OF KERATONYXIS.

Gleize, having commenced an operation by extraction, was prevented from completing it by a sudden movement of the patient's head: instead of enlarging the opening in the cornea with scissors, he introduced a needle through it, and depressed the lens. This case led to the invention of the new method of operating by *keratonyxis*, as it is now termed, a description of which Gleize published in 1786. Gleize's method was simplified by Conradi, who merely opened the cornea and capsule of the lens with a lance-shaped knife, and left the removal of the cataract to be effected by the absorbents. Several improvements were subsequently made in this method by Dr. H. Buchhorn, who first gave it the name of *Keratonyxis* (see *this word*), and adopted the practice of dividing the lens, as well as the capsule, and of bringing the fragments forward into the anterior chamber. About the same time, Mr. Saunders, in England, perfected a similar operation, and applied it particularly to congenital cataracts. (See *Guthrie's Operative Surgery of the Eye*, (pp. 331, 332.)

This operation requires the pupil to be first artificially dilated. The belladonna should be applied the day before, and on the morning of the operation, in order that the pupil may be completely dilated; and a few drops of a solution, in the proportion of five grains of the extract to a drachm of water, should be dropped into the eye, half an hour before its commencement, so as to prevent a contraction of the pupil during the operation. (*Guthrie, Op.* cit. p. 333.) The best method of keeping very young patients sufficiently steady during the performance of keratonyxis, is to bind their arms firmly to their side with a broad roller or folded sheet. They are then to be placed on a table in the recumbent position, and the head prevented from moving by an assistant pressing his hands firmly upon the temples. Keratonyxis admits of being divided into two stages: first, the introduction of the needle through the cornea and pupil as far as the cataract; and, secondly, the breaking of the lens to pieces, and the division and laceration of its capsule. For these purposes, Beer prefers a common, straight, spear-shaped, sharp-edged, couching-needle to any curved one, however fine it may be made; first, because it pierces the cornea with greater facility; secondly, because both a soft cataract and the capsule can be more effectually cut with it, a larger opening being made, through which the aqueous humour may flow over the fragments of the lens, and the dissolution of the cataract be thus rendered more certain; whereas, with a curved needle, Beer says, the lens can only be disturbed, and the capsule torn, under which circumstances, inflammation and a secondary capsular cataract are likely to be produced. He directs the instrument to be introduced either at the lower, or at the external part of the cornea, one line and a half from its margin, the point being directed obliquely towards the pupil, and the capsule is to be effectually cut by moving the extremity of the needle laterally in various ways: and, above all things, it is necessary at the time of breaking the lens piecemeal, not to let the instrument continue always within this body; but, at every stroke, to lift it completely out of the lens and capsule, and then introduce it into them again in different directions.

Dr. Jacob prefers, for the performance of this operation, a fine-sewing needle, curved at the point. He says, that it rarely or never leaves the slightest mark in the cornea. " The capsule can be opened to any extent; a soft or friable lens can be actually broken up into a pulp, by pushing the curved extremity of the needle into its centre, and revolving the handle between the fingers; large fragments can be taken up on the point of the needle from the anterior chamber, and forced back out of the way of the iris; or, if sufficiently soft, may be divided by pressing them against the back of the cornea with the convexity of the needle," &c. (See *Dublin Hospital Reports*, vol. iv. p. 224.)

Others give the preference to an extremely fine, small, and sharp needle, slightly flattened for a short distance from its point, and with cutting edges to facilitate its passage through the cornea. It should increase in size from its point, so that its introduction may not cause the escape of the aqueous humour. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 155.)

As Beer observes, keratonyxis must soon have been found as little adapted to all cataracts, as any other mode; for, otherwise, the suggestion would not have been made to practise *reclination* through the cornea. To this form of reclination, however, Beer adduces great objections; for, he says, that, in this manner, either the cataract cannot be properly turned if the iris be duly spared, but it will continue to lie obliquely, being always quite evident below the pupil, and very apt to rise again from the slightest cause; or it is indeed depressed far enough towards the bottom of the eye, but, however much the pupil may be artificially dilated, the pupillary edge of the iris is more or less injured, especially with the convexity of a curved needle. In addition to these considerations, Beer urges against this method all the objections, which apply to the practice of reclination through the sclerotica.

It may be necessary to repeat keratonyxis two, or three times, and this is more prudent, than doing too much injury on any one occasion. (*Middlemore*, vol. ii. p. 156.).

After the lens and capsule have been effectually cut in pieces, the same light mode of dressing and the same after-treatment are proper, as are adopted in cases of depression and reclination. Beer also particularly objects to any trials being immediately made of the eyesight. At the same time he assures us, that he has not met with any of the instances, so frequently mentioned in books, of persons, on whom keratonyxis has been done, seeing perfectly well, and having quite a clear pupil in a few days: under the most favourable circumstances, several weeks, and sometimes as many months, elapsed, before the pupil became quite transparent.

According to Beer, keratonyxis is not liable to many accidents. Sometimes, says he, the artificially dilated pupil contracts, as soon as the needle has pierced the cornea, and reached the cataract: in this circumstance, the operator must wait quietly, until the pupil gradually expands again, a change, which may be promoted by screening the eye with the hand. If the operation were to be continued without delay, either the pupillary edge of the iris would be seriously and dangerously hurt by the needle, or the cataract could not be effectually divided. When, contrary to expectation, the nucleus of the cataract is too hard to be broken piecemeal, reclination, and depression should be done through the cornea, as well as circumstances will allow, and these objects can be more easily effected with a part than with the whole, of the lens. When the lens is found completely fluid, but the capsule opaque only at some points, Beer, with the view of preventing a secondary capsular cataract, recommends cutting the membrane in all directions, and annihilating it as much as possible. Keratonyxis may be followed by the same evils, which occasionally take place after depression and reclination, and which will require similar treatment. But, according to Beer's experience, one of the most frequent consequences is a secondary capsular cataract, which often ensues even though the pupil was quite clear at the time of the operation; and though it may not quite blind the patient, it considerably lessens his power of vision; and renders the operation incomplete.

When the sole object of keratonyxis is to break and cut the cataract and its capsule piecemeal, and the fragments are to be left to dissolve and be absorbed, the operation can be indicated only where this division, breaking, dissolution, and absorption of the cataract can be successfully wrought. Hence, Beer sets down the method as not calculated for firm, hard, lenticular cataracts; nor for those which are softish and scabrous only upon their surface; and, he says, that it is not suited for capsulo-lenticular cataracts, nor for any cases, termed false cataracts, which are of a membranous nature. Keratonyxis, he observes, may be expected to answer only in fluid or gelatinous cataracts, when the capsule is either little or not at all opaque and thickened, and of course can be easily opened and cut to pieces, as in the case described under the name of encysted cataract. For the above reasons, the method is well adapted for children and young subjects, in whom the origin and general complications of a cataract involve the case in suspicious circumstances.

After keratonyxis, the dilatation of the pupil should be kept up, by means of belladonna, until all symptoms of inflammation have subsided. (See *Guthrie's Operative Surgery of the Eye*, p. 336.)

Langenbeck, who has practised keratonyxis to a considerable extent, and uses the curved, two-edged, lancet-shaped needle, thinks extraction preferable to it only when the whole cataract can be brought out at once, by means of gentle pressure on the eye, and with the aid of Daviel's curette, as in the case of a firm cataract; while he represents keratonyxis as most advantageous, where, by the manœuvre of opening the capsule, the mass of the cataract would be so divided by the instrument as not to admit of being extracted altogether; but would require the use of a scoop, forceps, or hook, for bringing out the fragments, as in examples of soft, milky, and capsular cataracts. Langenbeck also urges, as a reason against extracting soft cataracts, their greater size, whereby in their passage through the pupil in an entire state they may injure the iris. (*Neue Bibliothek für die Chir.* b. i. p. 461.).

Keratonyxis (the anterior operation of solution), and extraction, seem to Mr. Middlemore to comprise all the feasible operations, performed for the cure of lenticular cataract anterior to the iris; for he is unwilling to include reclination and depression, which he believes are more advantageously executed through the sclerotica. "If," says he, "we review the number and importance of the textures, which have been divided or injured, we find, that, with the exception of the parts actually implicated in the disease, the cornea alone is injured. At least, they are the only parts, the texture of which is necessarily penetrated." The cornea, it is well known, is not a highly sensible part; and hence the anterior keratonyxis and extraction give less pain, than other operations for cataract. (See *Middlemore on Dis. of the Eye,* vol. ii. p. 156.)

Although keratonyxis admits of being done upon both eyes with the same hand, Dupuytren does not consider it an easier or a better operation, than that of introducing the needle, through the sclerotica. The movements of the needle seem to him to be too much confined by the pupillary margin of the iris; the subsequent inflammation and nervous symptoms as great as after the other mode; the iris more exposed to injuries; and the wound sometimes followed by an opaque cicatrix. (*Clin. Chir.* t. i. p. 54.) Yet, the record of his own success with keratonyxis, in opposition to this statement, is remarkable; for, in a list of twenty-three cases collected by Dr. Marx, eleven were followed by immediate and permanent success; six proved successful at the expiration of a month; two were followed by nervous symptoms; and six by slight opthalmy; two by iritis; one by inflammation and atrophy of the eyeball; five by the continuance of fragments of the capsule at the edge of the pupil; in five a second and third operation were requisite; one lost his sight from inflammation; two others, from an opaque cicatrix; and two from amaurosis, independently of the operation, or its consequences. At all events, however, seventeen out of twenty-one recovered their sight. (See *Dupuytren* in *Clin. Chir.* t. i. p. 55.) This was about equal to the success with the needle behind the sclerotica. Dupuytren did not, therefore, give up keratonyxis, but even preferred it to the foregoing method, and also to extraction, when the orbit projected a good deal; the interspace between the eyelids was narrow; the eye diminutive and sunk; the organ affected with spasmodic movements, as particularly exemplified in children, and when the centre of the capsule was the seat of cataract. (p. 57.)

Valuable information on keratonyxis has been published by Langenbeck in the 4th vol. of his first Bibliothek; in the 1st vol. of his new Bibl. p. 1, &c. 1815; and in a tract, entitled, " *Prüfung der Keratonyxis, einer Methode den grauen Staar durch die Hornhaut zu recliniren, oder zuzerstuckeln nebst erläuternden Operations geschichten.* Göttingen, 1811. See also *Conradi, in Arnemann's Magazin,* b. i. p. 95. 1791. *Gleize, Nouvelles Obs. Pratiques sur les Maladies de l'Œil,* p. 118. 1812. *G. H. Buchhorn's Diss. de Keratonyxide,* Halæ, 1811.

OF CONGENITAL CATARACT.

I shall not stop here to inquire, whether the expression *congenital cataract* is used with strict propriety; but the term is reprobated by Beer as being in general incorrectly applied.

So much has been already said in a preceding section of this article, concerning the propriety and striking advantages of operating for the cataracts of children, that to expatiate further upon this point would be a mere waste of time.

We have noticed the case, which Scarpa terms the *primary membranous cataract,* and which is mentioned by that distinguished professor, as being met with in children, or young people, under the age of twenty, the substance of the crystalline itself being almost entirely absorbed, while the capsule is left in an opaque state, including, at most, only a small nucleus, not larger than a pin's head. This disease is described by Scarpa as being exceedingly rare, and characterised by a certain transparency and similitude to a cobweb; by a whitish opaque point, either at its centre or circumference, and by a streaked and reticulated appearance. Now, this example, which is represented by Scarpa as rare, appears from the experience of Mr. Saunders, to be by no means uncommon; since at the London Infirmary for diseases of the eye, it was found, that the majority of congenital cataracts were capsular, or membranous. This last statement is also at variance with that of the late Mr. Gibson, who has asserted that, in infants, the cataract is generally fluid. (*Edin. Medical and Surgical Journal,* vol. vii. p. 397.) Ware also asserts, that, in children, born with cataracts, the crystalline humour has generally, if not always, been found either in a soft or fluid state. (*Obs. on the Cataract, and Gutta Serena,* vol. ii. p. 380.) We learn from Mr. Saunders's publication, that, in the congenital cataract, after the crystalline lens has been converted into an opaque substance, it is gradually absorbed; and, in proportion to the progress of absorption, the anterior lamella of the capsule approaches the posterior, until they form one membrane, which is white, opaque, and very elastic. This process is commonly completed long before the eighth year, and the operator will now find a substance, which he will in vain endeavour either to extract or depress. But there is one form of the congenital cataract, in which the absorption of the lens does not proceed, viz. when the centre of the lens is opaque, and its circumference is perfectly transparent. Should the capsule and lens be penetrated, however, with any instrument, the opacity soon becomes complete, and from this moment the substance of the lens begins to be absorbed.

According to the experience of Mr. Saunders in congenital cataract, the lens may be either solid, soft, or fluid, but more frequently it is partially or completely absorbed, and the cataract is capsular.

The circumstance of Mr. Gibson's never having met with a simple membranous cataract in an infant, a fact so much at variance with Mr. Saunders's account, is conceived by Mr. Guthrie to admit of satisfactory explanation by the inference, that Mr. Gibson, in Manchester, probably saw all the children there with congenital cataract soon after they were born, and before the absorption of the lens had proceeded far; while a great number of Mr. Saunders's congenital cases were brought to him in London from distant places, and not seen by him till the children were older, and the disease had made greater progress. (*Operative Surgery of the Eye,* p. 359.) Indeed, Mr. Gibson states himself, that simple membranous cataracts are by no means uncommon at the age of eight or ten, as well as in adults, who have been born blind. (See *Edin. Med. and Surg. Journ.* vol. viii. p. 399.)

The following table of forty-four cases is given in Mr. Saunders's work, for the purpose of showing in what proportion each species of cataract has been found to prevail in congenital cases:—

Solid opaque lens, with or without opacity of the capsule. Three single, two double cataracts	5
Solid lens, opaque in the centre, transparent in the circumference, with capsule in the same state. Five double - - - -	5

Soft opaque lens, with or without opacity of the capsule. Two single, two double	4
Soft opaque lens, with solid nucleus. One single, two double	3
Soft opaque lens, with dotted capsule, the spots white, the spaces transparent. Two double	2
Fluid cataract, with opacity of the capsule. Two single	2
Fluid cataract, with opacity of the capsule, and closed pupil. Two double	2
Opaque and thickened capsule, the lens being completely absorbed, or the remains of it being thin and squamose. Six single, twelve double	18
Opaque and thickened capsule, with only a very small nucleus of the lens unabsorbed in the centre. Two single	2
Opaque and thickened capsule in the centre, remains of the lens in the circumference. One double	1

Here the corresponding character of congenital cataracts in the eyes of each individual is exhibited by the number of double cases, and we are informed, that the same character was preserved in the cataracts of several children of the same family. (*Saunders on Diseases of the Eye, edit. by Dr. Farre,* pp. 135, 136.)

Mr. Lawrence observes, that the congenital cataract "is sometimes lenticular, but more frequently capsulo-lenticular. The lens is usually opaque throughout; generally of its natural consistence, which is gelatinous, sometimes softer, or even fluid, but *never hard.* After losing its transparency, the crystalline lens frequently undergoes absorption: hence, we often find it lessened, reduced to a small fragment, or as thin as a wafer." (*On Dis. of the Eye*, p. 443.) With reference to the statement, that a congenital cataract is *never hard*, I may mention that Mr. Alexander, this autumn (1836), in the presence of Mr. Bainbridge of Tooting and myself, extracted from the eye of a young woman, aged eighteen, who had congenital cataracts, a lens, which was as hard as that of the eye of a boiled mackarel. Another gentleman of great experience in this subject believes, that, when lenticular cataract occurs in very early life, it is *always soft*, unless the lens be the seat of cretaceous, or osseous deposition. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 94.)

Congenital cataract appears frequently to afflict several children of the same parents. In the course of the present article, I have already had occasion to advert to two striking examples of this fact. The first is related by Mr. Lucas, who attended five children of a clergyman at Leaven, near Beverley, all born with cataracts. (See *Med. Obs. and Inquiries,* vol. vi.) The second is mentioned by Mr. Gibson who, saw five, or six children, the families of two sisters, who were all totally blind, and in an idiotic state, having cataracts accompanied with amaurosis. (*Edin. Med. and Surgical Journal*, vol. viii. p. 398.) Several instances occurred to the late Mr. Saunders. In one family, two brothers were thus afflicted. In a second family, two brothers, twins, became blind with cataracts at the age of twenty-one months, each within a few days of the other. It is remarkable, that the four cataracts had precisely the same character. In a third family, a brother and two sisters were born with this disease. The eldest sister was affected with it only in one eye, the brother and youngest sister in both eyes. In a fourth family, three brothers and a sister had all congenital cataracts. (*Saunders on Diseases of the Eye*, pp. 134, 135.) One very remarkable example is recorded by Dupuytren, (See *Clin. Chir.* t. i. p. 39.) where a lady, her daughter and three grand-children, were all afflicted with cataract.

Children with congenital cataracts possess various degrees of vision; but, when they are totally blind, their eyes not being attracted by external objects, volition is not exercised over the muscles of these organs, which roll about with an irregular, rapid, and trembling motion.

I shall now proceed to speak of the manner of operating upon children. Until the time of Pott, the intention of surgeons, in couching, or depressing the cataract (as indeed the expression itself implies), was to push the opaque crystalline downward, away from the pupil. Pott, conscious that the cataract often existed in a fluid or soft state, was aware that it could not then be depressed; and, therefore, in such cases, he recommended using the couching-needle for the express purpose of breaking down the cataract, and of making a large aperture in the capsule, so that the aqueous humour, which he believed to be a solvent for the opaque crystalline, might come into immediate contact with this body. This operation subsequently to Pott, has been strongly and ably recommended by Hey, of Leeds, and Professor Scarpa, of Pavia. In the cases of children, it even received the approbation of Ware. (*On the Operation of Puncturing the Capsule of the Crystalline Humour*, p. 9.)

But, notwithstanding the utility and efficacy of lacerating the front layer of the crystalline capsule had been so much insisted upon by Scarpa and others, their observations were confined to the cataract in the adult subject, and, before the example set by Saunders, no one (excepting, perhaps, Gibson of Manchester) ventured to apply, as a regular and successful practice, such an operation to the eyes of infants and children.

The principle, on which Saunders proceeded in his operations on the congenital cataract, was founded on the opinion, that the only obstacle to the absorption of the opaque lens is the capsule; and that, as the latter also is most generally opaque, "the business of art is to effect a permanent aperture in the centre of this membrane. This applies to every case of congenital cataract which can occur." Saunders used to overcome the difficulty of operating upon children, by fixing the eyeball with Pellier's elevator, having the patient held by four or five assistants, dilating the pupil with belladonna, and employing a very slender needle, armed with a cutting edge from its shoulders to its point, and furnished with a sharp point, calculated to penetrate with the utmost facility.

Before the operation, the extract of belladonna, diluted with water to the consistence of cream, is to be dropped into the eye, or, to avoid irritation, the extract itself may be smeared in considerable quantity, over the eyelid and brow. In less than an hour, if there be no adhesions, it produces a full dilatation of the pupil, exposing to view nearly the whole anterior surface of the cataract. The application should then be washed from the appendages of the eye.

In using the needle, Saunders most carefully abstained from doing any injury to the vitreous humour, or its capsule, and it was an essential point with him to avoid displacing the lens. In directing the extremity of the instrument to the centre of the capsule, he passed it either through the cornea, near the edge of this membrane (the operation now called *keratonyxis*), or through the selerotica, a little way behind the iris. By the first, which is called the *anterior* operation, Mr. Saunders conceived, that less injury would be inflicted, and less irritation excited, than by introducing the needle behind the iris, through all the tunics of the eye. In every case, the first thing aimed at was the permanent destruction of the central portion of the capsule to an extent equal to that of the natural size of the pupil. If the capsule contained an opaque lens, Saunders used next to sink the needle gently into the body of the crystalline, and moderately open its texture, cautiously observing not to move the lens at all out of its natural situation.

When the case was a fluid cataract, Saunders was content in the first operation with simply lacerating the centre of the capsule, being desirous of avoiding to increase the irritation following the diffusion of the matter of the cataract in the aqueous humour.

When the cataract was entirely capsular, Saunders acted with rather more freedom, as he entertained in this case less fear of inflammation: but, in other respects, he proceeded with the same objects in view, which have been already related, and of which the principal consisted in effecting a permanent aperture in the centre of the capsule, without detaching this membrane at its circumference; for then the pupil would have been more or less covered by it, and the operation imperfect, "because this thickened capsule is never absorbed, and the pendulous flap is incapable of presenting a sufficient resistance to the needle to admit of being removed by a second operation." (P. 145.)

Mr. Saunders found, that the greatest success attended the operation between the ages of eighteen months and four years. One operation frequently accomplished a cure; so many as five were seldom requisite.

The only particularity, in Saunders's treatment of the eye after the operation, was that of applying the belladonna externally, for the purpose of making the pupil remain dilated, till the inflammation had ceased, so as to keep the edge of the iris from contracting adhesions with the margin of the torn capsule. This last practice is found to be so important, that it is never neglected by any good operator of the present day. In leaving this part of the subject, I must advise every surgeon to read the interesting account of Saunders's practice, published by his friend and colleague, Dr. Farre.

It seems to Mr. Middlemore, that, in cases of congenital cataract, when the patient is not more than six years old, keratonyxis is preferable to every other operation; "because it is very easily performed, gives very little pain, and is fully adequate to the cure of the disease. The puncture of the cornea is certainly much less painful than the puncture of the sclerotica. If, however, we are disposed to operate upon an infant, a few months after birth, the thickness of the cornea, and the proximity of the iris to its neural surface, would render this operation objectionable. It would then be better to perform the posterior operation of solution; for, it would not at that age be very easy to pass the needle through the cornea without injuring the iris." (See *Middlemore Op.* cit. vol. ii. p. 106.) Gibson appears to have been unacquainted with the usefulness of the extract of belladonna in preparing the eye for the operation. A few hours before operating, he was in the habit of ordering an opiate, sufficient to produce a considerable degree of drowsiness, so that the infant generally allowed its eyelids to be opened, and properly secured without resistance, and was little inclined to offer any impediment to the introduction of the couching-needle; but, on the contrary, presented the sclerotica to view, naturally turning up the white of its eye. If the infant was more than a year old, and whenever it was necessary, Gibson used to introduce its body and arms into a kind of sack, open at both ends, and furnished with strings to draw round the neck, and tie sufficiently tight round the legs, so that its hands were effectually secured, and the assistants had only to steady its body, and fix its head, whilst the child was laid on a table, upon a pillow. Mr. Gibson never found it necessary to use a speculum, having uniformly experienced that, after the couching-needle was introduced, he had no difficulty in commanding the eye, aided by a slight degree of pressure upon the eyeball with the index and middle fingers of his left hand, which were employed in depressing the lower eyelid. He admits, however, that the speculum can easily be applied, if an operator prefer it. He generally used Scarpa's needle; because, in infants, the free rupture of the capsule of the lens ought commonly to be aimed at, in order that the milky cataract may escape, and mix with the aqueous humour; or, if the cataract be soft, that the aqueous humour may be freely admitted to its pulpy substance which has been previously broken down with the needle. He thinks, that no peculiarity is necessary in depressing the hard cataract of infants. Before Scarpa's needle was known in this country, Mr. Gibson used Mr. Hey's, which was generally effectual, and, as he conceives, possesses the recommendation of being less liable to have its points entangled in the iris. He says, that, when a milky cataract has been thus evacuated, it renders the aqueous humour turbid; but, that, within the space of two days, the eye generally acquires its natural transparency, and vision commences. When the capsule and substance of the soft cataract have been broken down, and the aqueous humour has come into contact with the lens, the solution and disappearance of the cataract, in all the cases upon which Mr. Gibson has operated, have uniformly taken place, in a short time. (See *Edin. Med. and Surgical Journal*, vol. viii. pp. 398, 399.)

For the purpose of fixing the eye, Ware considered Pellier's elevator requisite in operating upon infants. When the patient, however, had advanced beyond the age of infancy, he sometimes fixed the eye by means of the fingers alone. For the purpose of puncturing the capsule, and breaking down the cataract, this gentleman gave the preference to an instrument, which resembles one recommended by Cheselden, for the purpose of making an artificial pupil; but it is somewhat narrower. Its blade indeed is so narrow, that it nearly resembles a needle. Its extremity is pointed, and it cuts on one side for the space of about the eighth of an inch, the other side being blunt. It is perfectly straight; is an inch long in the blade; and forms a complete wedge through its whole length. Upon one side of the handle is a coloured spot, by attending to which, the operator may always ascertain the position of the instrument in the eye.

Ware dilated the pupil with the extractum belladonnæ, softened with a little water, and applied about half an hour before the time of operating. He believed, that, in operating upon infants, the surgeon might perform the operation with more composure, if the patient were laid upon a table, with the head properly raised on a pillow. The bent end of Pellier's elevator should be introduced under the upper eyelid, and the instrument committed to the care of an assistant. If the right eye is to undergo the operation, and the surgeon operate with his right hand, he must of course sit or stand behind the patient; and, in this case, he will himself manage the speculum with his left hand. The eye being thus fixed, Ware passed the point of the narrow-bladed knife above mentioned through the sclerotica, on the side next to the temple, about the eighth of an inch from the union of that membrane to the cornea, the blunt edge being turned downwards. The instrument was pushed forwards in the same direction, until its point had nearly reached the centre of the crystalline. The point was then brought forwards, until it had passed through the opaque crystalline and its capsule, and was plainly visible in the anterior chamber. If the cataract was fluid, and the anterior chamber became immediately filled with the opaque matter, Ware deemed it advisable to withdraw the instrument, and defer further measures until the matter had been absorbed, which absorption usually took place in the course of a few days, and sometimes of a few hours. If no visible change were produced in the pupil, the point and cutting edge of the instrument were applied in different directions, so as to divide both the opaque crystalline and its capsule into small portions, and, if possible, bring them forwards into the anterior chamber. This may require the instrument to be kept in the eye for a minute or two; but, if the operator preserve his steadiness, he may continue it there a much longer time without doing the least injury to the iris, or to any other part. If the cataract be found of a firm consistence (though this rarely happens in young persons), it may be advisable to depress it below the pupil; and in such a case particular care should be taken to perforate largely the posterior part of the capsule, and to withdraw the instrument immediately after the cataract has been depressed, in order to hinder it from rising again. If the opacity be in the capsule, the instrument will not act so easily upon it as it does on the opaque crystalline; but, notwithstanding this, the capsule, as well as the crystalline, may be divided by it into larger or smaller portions, which, when thus divided, will be softened by the action of the aqueous humour; and though, in the first operation on such a case, says Mr. Ware, it may not be possible to remove the opacity, yet, on the second or third attempt, the divided portions may be brought forwards into the anterior chamber, in which place they will then be gradually absorbed, and soon disappear. After the operation, Ware seldom found it necessary to take away blood from children or persons under the age of twenty. He continued a cooling antiphlogistic treatment a few days. After this, if any opaque matter remained, he expedited its absorption by dropping a small portion of powdered sugar into the eye once or twice a day. When, at the end of a week or ten days, the inflammation was over, and the pupil obstructed with opaque matter, Ware advised a repetition of the operation. After a similar interval, the operation, he says, may be requisite again. In most cases, Ware was obliged to operate twice; in a few instances, once proved sufficient; and only in three, out of the last twenty, did he find it necessary to operate a fourth time. (*On Puncturing the Capsule of the Crystalline Humour.*)

I think any impartial man, who considers the practice of the three preceding operators, will find great cause to admire the superior gentleness and skill which predominate in the operations of the late Mr. Saunders. For my own part, I am so fully convinced of the mischief, which has been done to the eyes, by the rash boldness, awkwardness, and unsteadiness of numerous operators, that the inculcation of gentleness and forbearance, in all operations for the cataract, seems to me the bounden duty of every man, who has occasion to write upon the subject; and I do not agree with my friend Mr. Guthrie that students ought to be taught, that "the eye is not a delicate organ; and that it will suffer more comparative violence than any other of importance in the whole body." (*On Certainty, &c. of Extraction, &c.* p. 11.)

Great manual skill, and invariable gentleness, indeed, seem to me to have had more share in rendering Mr. Saunders's operation successful, than any particularity either in his method or his instrument. I have no hesitation in declaring my own partiality to the principles, on which his practice was founded, and my belief, that they are well calculated to improve most materially this interesting branch of surgery. In conclusion, I shall mention Mr. Guthrie's general opinion, respecting the kinds of operation suited for the three classes of cataracts, into which he arranges them for the consideration of this important point: the *hard* admit only of extraction, or displacement; the *soft*, seldom of displacement, or of extraction, but usually of division; the *capsular*, neither of displacement, extraction, nor division, purely considered as such, but by laceration, and removal of the opaque body from the axis of vision by different operations, which, although they may partake of the nature of all, are yet not precisely either. All intermediate states of disease, such, for instance, as the caseous and fluid cataracts, admit of some slight deviations from these rules, but are still regulated by the same principles. (*Operative Surgery of the Eye*, p. 365.)

With respect to extraction, also, it deserves careful recollection, that it is a method, which, though the cataract may be of a hard consistency, is often prohibited by various unfavourable circumstances, which I have taken notice of in the foregoing pages. When cataract takes place in an extremely old, or in a very feeble individual, reclination, or depression is preferred by Mr. Middlemore to extraction, unless there be reason to believe, that the lens is unusually large. The ground for this preference is the tendency of the cornea to slough in such persons, and the hazard of there being an insufficient degree of reparative power to effect the union of the divided cornea. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 111.) Yet, I have known incisions in the cornea heal as favourably in extremely old persons, as in young.

The case of the late Sir William Blizard, who had a cataract extracted by Mr. Lawrence at the age of ninety, was a memorable example of it.

When the crystalline lens is extracted, depressed, or destroyed, vision can never be restored to its original power. Some near-sighted persons, in whom the power of refraction is too great, regain ordinary vision; but far-sighted individuals see worse, than they did previously to the formation of the cataract. These will require convex glasses, which, however, they should not begin to employ till long after the operation, lest the intensity of the impression produced by them should bring on inflammation of the eye, and deprive the patient of the benefit already derived from the operation. (See *Dupuytren Clin. Chir.* t. i. p. 77.) Some weeks, says another experienced surgeon, should elapse, before the patient begins to use his glasses, and he will act prudently in employing spectacles at all times sparingly. (See *Lawrence on Dis. of the Eye*, p. 427.)

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CATHETER, (from καθίημι, to thrust into.) A tube which is introduced through the urethra into the bladder, for the purpose of drawing off the urine when it has accumulated in this organ, and cannot be discharged in the natural way (see Urine, Retention of); or sometimes for promoting its quick evacuation as soon as it has descended from the kidneys, as where the bladder, or urethra has given way, or been wounded; and it is a matter of urgent importance to prevent any further effusion of urine. Here the patient's chance of preservation will depend partly upon free incisions for the discharge of the urine already effused, and partly upon the prompt use of the catheter, to hinder fresh quantities of this fluid from getting into the cellular tissue, or even sometimes into the cavity of the peritoneum, as in a wound or rupture of the bladder. (See Bladder, Gunshot Wounds, and Wounds.) Catheters are also very important means in the treatment of strictures of the urethra, and fistulæ in perinæo. (See Fistulæ in Perinæo; Urethra, Strictures of; and Urinary Abscesses.) Occasionally, they are employed for the injection of fluid into the bladder, as where coagula, are lodged in this vicus, or where it is advantageous to have it in a distended state during the performance of an operation, as that of *Lithotrity*. (See this word.) Of course, there are two kinds of catheters; one intended for the male; the other, for the female urethra. With respect to catheters, three things are to be considered:—1st, the instrument itself; 2d, the manner of introducing it; and 3d, the conduct to be pursued after its introduction.

Catheters were anciently composed of copper; Celsus knew of no other kind. As these, however, had the inconvenience of becoming incrusted with verdigrise, they at length fell into disuse, and others, made of silver, were substituted for them. This change, which was made as early as the time of the Arabian practitioners, still receives the approbation of the best modern surgeons. A common silver catheter is a tube, of such a diameter as will allow it to be introduced with ease into the urethra, and of various figures and lengths, according as it is intended for the young or adult, the male or female, subject. For an adult female it should be about six inches long; and, for young girls, four or five. For men, the length ought to be from ten inches and a half to eleven inches. But, as the instrument need not enter far into the bladder, Mr. John Bell's advice to avoid too great a length merits observance. (*Principles of Surgery*, vol. ii. p. 193.) In cases of diseased prostate gland, the catheter should be much longer, than in others. (See Prostate Gland.) As the urethra in some instances is narrow, and in others, wide, surgeons should be furnished with catheters of different diameters. The choice of the instrument, with respect to its width, is likewise determined very much by the nature of the disease of the urethra. (*Langenbeck, Bibl.* b. i. p. 1177.) For a woman, the diameter ought to be at least two lines; and for girls, a line and a half. For male adult subjects, Desault recommends the thickness of two lines and one-third; and, for boys, that of a line and a half. In general, whenever the urethra is pervious, it is better to follow the advice of Desault, and employ a largish catheter, which will enter the passage more easily, and not be entangled in the folds of the membranous lining of the canal, while it will afford a more ready outlet for the urine. On the other hand, a small catheter should be preferred, when there are obstructions in the passage. Catheters also differ in shape: those which Desault used for male subjects had only a slight curvature of one-third of their length; a curvature, which began insensibly from their straight part, and was continued to the very end of their beaks. The curvature was also regular, so as to form the segment of a circle of six French inches in diameter. Amussat recommends the use of straight catheters, which are passed as far as the pubes, while the penis is drawn upwards, which is then brought down between the thighs so as to lessen the bend of the urethra. One advantage imputed to a straight catheter is, that it may be rotated between the surgeon's fingers, whereby the chance of its surmounting every obstacle will be increased. (*Archives Gén. de Méd.* t. iv. Also *P. Ecot, Diss. du Catharisme exercée avec la Sonde droite*, Strasb., 1825, 4to.) As the course of the healthy urethra in the male subject is regular, the caprice evinced by surgeons in the different curvatures of their catheters, cannot be founded on any correct anatomical principles, and the bend of the instrument (at least for subjects of the same age and stature) should generally not vary at all, but be strictly adapted, as Langenbeck remarks, to the natural track of the urethra. (*Bibl.* i. p. 1177.) The female catheter, however, has only a slight curvature towards its beak; a shape adapted to the direction of the meatus urinarius. Desault also improved silver catheters, by causing them to be made with elliptical openings, or eyes, at the sides of the beak, with rounded edges, instead of the longitudinal slits previously in use, in which the lining of the urethra was frequently entangled, pinched, and lacerated, so that acute pain and profuse hemorrhage were the consequences. With the view of preventing these evils, he also filled up the openings with lard. (See *Œuvres Chir. de Desault*, t. iii. p. 118.) On each side of the external end of the catheter is a small ring, by means of which, and some tape, it can be fixed.

Besides silver catheters, surgeons now frequently employ flexible ones made of elastic gum. These last, indeed, are of so much importance, that they may be said to constitute one of the greatest improvements in modern surgery. I shall not here inquire, whether they were first invented by Theden, Pickel of Wurzburg, or Bernard of Paris; this is a point which the Germans and French must settle themselves. Imperfect attempts had been made by others at earlier periods to invent catheters possessing the property of flexibility. Van Helmont proposed the use of catheters made of horn; but this substance was found to be too stiff, and to be very quickly coated with depositions from the urine. Fabricius ab Aquapendente employed leather catheters, which were objectionable, inasmuch as they were soon softened by the urine and mucus of the urethra, when they shrivelled and became impervious. Other flexible catheters were also formerly tried, composed of spiral springs of silver wire, covered with the skins of particular animals. These last, however, were quickly spoiled by putrefaction; and when left in the urethra any considerable time, the beak sometimes entirely separated from the rest of the instrument and was left behind in the bladder.

The gum catheters, now in use, are liable to none of the preceding inconveniences; they are formed of silk tubes, woven for the purpose, and covered with a coat of elastic gum; they are sufficiently flexible to accommodate themselves to the different curvatures of the urethra; they are not softened by the urine; and they constantly remain with their cavity unobliterated. Their smooth and polished surface makes them continue a long while free from incrustations, deposited from the urine. Sometimes they are introduced with a stilet, or wire, which is passed into their canal, in order to give them a certain curvature, and a greater degree of firmness; but, in general, it is withdrawn as soon as the tube is in the bladder.

Elastic catheters are less irritating to the urethra, and less apt to become covered with calculous incrustations, than silver tubes; they can also be frequently introduced, when a metallic one will not pass.

The selection of good bougies and catheters, especially for the male subject, is a business of the first-rate importance; for, by employing such as are disposed to break, "many a practitioner has doomed his patient to years of dreadful, and, perhaps hopeless suffering, and brought down irreparable disgrace upon his own head." (*Med. Chir. Journ.* vol. v. p. 75.) M. Nicod, in performing the operation of lithotomy upon a male, found the stone, which was very brittle, one inch and a half long, and eight or nine lines thick, traversed, in the direction of its greater diameter, by a piece of elastic gum catheter, which had acted as a neucleus for the deposition of calcareous matter. (See *Obs. sur le Danger d'employer des mauvaises Sondes de Gomme élastique; Journ de Médecine, par Leroux*, Oct. 1816.) A short time ago, M. Roux was obliged to cut into the bladder to extract an elastic gum catheter, which, in consequence of not having been properly secured, had slipped into that viscus. (See *Velpeau, Nouv. Elém. de Méd. Opér.* t. iii. p. 921.)

Formerly, the best elastic catheters used to be fabricated at Paris; but such as are now made in London are in some respects better than French, being generally more regular. Gum catheters are of twelve different sizes, which correspond to twelve holes in a plate of brass. "Each catheter, therefore (says Mr. Crosse) has its size designated by its number, which greatly facilitates the ascertaining of the progress of the case towards a cure. Numbers 1 and 2 are smaller than can be procured in England, and are so slender that I thought there might be danger of their breaking, until I was convinced, by seeing the method of making them, that there is no reason for fearing any such thing. A firm tissue of silk is woven upon a brass stilet, of the size of the cavity of the instrument to be made. In weaving this tissue, the orifice or eye is left, and the whole therefore consists of one entire thread. The successive layers of varnish are deposited on the outer surface of the silken tissue, their number depending on the size of the instrument; and each coating of varnish undergoes a long process of scouring before the next is put on, for which purpose women are employed by Feburier." (See *Sketches of the Medical Schools of Paris*, by J. G. Crosse, 1815, pp. 122, 123.)

According to this gentleman, however, English gum catheters possess advantages:—"They retain their curve better without the stilet, are less liable to crack, and have eyes more smooth and better formed." (P. 124.) In London, elastic catheters as small as the French, are now also brought to perfection.

When the object of passing a catheter is merely to empty the bladder, without any design of leaving the instrument afterwards in the urethra, Langenbeck prefers one made of silver. (*Bibl. für die Chir.* b. i. p. 1176. Also *Velpeau, Méd. Opér.* t. iii. p. 912.)

In retention of urine from stricture, a surgeon will often succeed in introducing into the bladder a silver catheter, or an elastic gum catheter, mounted on a firm iron stilet. The catheter, recommended on such an occasion by Sir Benjamin Brodie, if the stricture be of *recent formation*, is nearly of the full size of the urethra; but, if the stricture has been of *long duration*, the instrument should be considerably smaller. He also prefers one, which is shorter, and less curved, than an ordinary silver catheter; and which is fixed in a wooden handle, whereby it is rendered more manageable. (*On Dis. of Urinary Organs*, p. 34. ed. 2.) If an elastic gum catheter is used, he says, that the iron stilet should have a flat handle, like that of a common sound. (See URINE, RETENTION of.) In retention of urine from chronic enlargement of the prostate gland, Sir B. Brodie rarely uses any thing but a gum catheter, which has one advantage, viz. that it may be retained in the urethra and bladder, with very little inconvenience to the patient, which is not the case with a silver catheter. (*Brodie Op.* cit. p. 143.)

Sometimes spasm about the perineum renders the introduction of a catheter difficult. In this case, a dose of opium should be administered before a second attempt is made. When inflammation prevails in the passage, the introduction may often be facilitated by a previous bleeding.

The operation of introducing the catheter may be performed, either when the patient is standing up, sitting, or lying down, which last posture is the most favourable. In order to pass a catheter with ease and dexterity, the following circumstances must be observed: — The instrument must be of suitable shape and size; a just idea of the perineum and curvature of the urethra must be entertained; the catheter must be introduced with the greatest care and delicacy; and the relaxation of the abdominal muscles has been insisted upon. (*Langenbeck*, Bibl. i. p. 1177.), though I confess, that it does not appear to me how this circumstance is of importance.

A catheter should always be used with a light hand, and held, as it were, loosely in the fingers. "It will then in great measure find its own way in that direction, in which there is the least resistance. If you grasp it firmly, it can only go where you direct it, and it is likely to puncture and lacerate the membrane of the urethra, and the substance of the prostate, and to make a false passage." (See *Brodie on Dis. of the Urin. Organs*, p. 145. ed. 2.) Force, says another distinguished surgeon, is never necessary. The instrument should be allowed to find its way, as much by the influence of its own weight, as by that of any extraneous power. If it meets with resistance, it is to be withdrawn a little way, and then tried in another direction. (See *Velpeau, Nouv. Elém.* &c. t. iii. p. 915.)

One of the most important maxims is, never to force forward the instrument when it is stopped by any obstacle. If there are no strictures, the stoppage of the catheter is always owing to one of the following circumstances:—Its beak may be pushed against the os pubis. This chiefly occurs when the handle of the instrument is prematurely depressed. Here the employment of force can obviously do no good, and may be productive of serious mischief. The beak of the catheter may take a wrong direction, and push against the side of the urethra, especially at its membranous part, which it may dilate into a kind of pouch. In this circumstance, if force were exerted it would certainly lacerate the urethra, and occasion a false passage. The end of the catheter may be entangled in a fold of the lining of the urethra, and here force would be equally wrong. Lastly, the point of the instrument may be stopped by the prostate gland, in which case force can be of no service, and may do great harm. Hence, it is always proper to withdraw the instrument a little, and then push it on gently in a different position.

There are three methods of introducing a male catheter, viz. with the concavity, in the first stage of the operation, directed either towards the abdomen, towards the left groin, or towards the surgeon himself. Of course, the latter plan requires the instrument to be turned so as to place its concavity upwards, as soon as the beak has arrived in the perineum; and hence the French surgeons call this method the "tour de maître."

The operation may be divided into three stages. In the first, the catheter passes, in the male subject, that portion of the urethra which is surrounded by the corpus spongiosum; in the second, it passes the membranous part of the canal, situated between the bulb and the prostate gland; and in the third, it enters the gland, and the neck of the bladder.

In the first stage, little trouble is usually experienced; for the canal is here so supported by the surrounding corpus spongiosum, that it cannot easily be pushed into the form of a pouch, in which the end of the instrument can be entangled.

When the catheter is to be introduced with its concavity towards the abdomen, and the patient is in the recumbent posture, the thighs are to be separated, and the legs moderately bent. The surgeon is to draw back the prepuce, and to hold the penis between the thumb and forefinger of his left hand, which are to be applied on each side of the corona glandis, and not at all to the under surface of the penis, so as to avoid pressing upon the commencement of the urethra. After the catheter has been well oiled, its handle is to be held between the thumb and forefinger of the right hand, and to rest with the back of the little finger upon the patient's abdomen, in the vicinity of the navel. Now, while the handle is parallel to the axis of the body, the beak is to be introduced into the urethra; the penis being extended, and drawn forwards, as it were, over the instrument, while the latter is gently pushed on, until its beak has reached the arch of the pubes. When the penis cannot be drawn further over the catheter, the beak has arrived in this situation, where it stops in front of the arch, and is pressing against the posterior side of the urethra. At this particular moment, the handle is to be depressed towards the patient's thighs, and the manœuvre well managed generally directs the end of the catheter at once through the prostatic portion of the urethra into the cavity of the bladder. In short, as soon as the beak of the instrument has passed under the arch of the pubes, and the surgeon very slowly brings the handle forwards, or downwards, the beak is elevated, and glides into the bladder. In this stage of the operation, the penis must be allowed to sink down, and not be kept tense, as this would only render the passage of the instrument more difficult.

The operation, however, is not always successfully accomplished. The beak of the catheter may be stopped by the margin of the urethral opening in the deep perineal fascia; or it may take a wrong direction, so as to push the membranous part of the urethra to one side or the other.

The first kind of impediment is best avoided by not depressing the handle of the catheter too soon; that is, before the point has passed beyond the arch of the pubes. When the membranous part of the urethra is pushed to one side or the other, the instrument ought to be withdrawn a little, and then pushed gently on in a different direction; but, if this expedient is unavailing, the index finger of the left hand may be introduced into the rectum, for the purpose of raising up the membranous part of the urethra, and guiding the extremity of the catheter. The passage of the catheter through the opening in the deep perineal fascia, and especially the attempt to hit the entrance of the prostate gland are the most difficult things in the operation. It is by using too much force, and directing the end of the catheter in a wrong manner, that unskilful surgeons sometimes rupture the membranous portion of the urethra.

When the prostate gland is enlarged, the urethra becomes lengthened; and, as it approaches the bladder, it makes a more sudden turn upwards than is natural. The catheter, therefore, should be longer, and more bent in that direction, than in other cases.

In the third stage of the operation, the beak of the instrument has to pass the prostate gland and neck of the bladder. The principal obstacles to its passage, in this situation, arise from spasm of the neck of the bladder, and muscles in the perineum, and from the instrument being pushed against the prostate gland, instead of into the continuation of the urethra through it. The first impediment may generally be obviated by waiting a few moments, and gently rubbing the perineum, before attempting to push the catheter further into the passage. The hinderance, caused by the prostate, is best eluded by using an instrument, the end of which is more curved than its other part.

When the catheter has turned round the pubes, and is just about to enter the neck of the bladder, is the critical moment, at which may be seen whether a surgeon can or cannot manage the operation with skill; for if he knows how to pass the instrument, he suddenly, but not violently, changes its direction. He depresses the handle with a particular kind of address, and raises the point, which, as if it had suddenly surmounted some obstacle, slips into the neck of the bladder, and the urine bursts out in a jet from the mouth of the catheter.

They who are unskilful press the tube forward, and persist, as they first began, in drawing up the penis, on the supposition that, by stretching this part, they lengthen the urethra, and make it straight, whereas they elongate only that part of the canal into which the catheter has already passed. (*John Bell's Principles of Surgery*, vol. ii. p. 213.)

Dr. Quain's view of some of the foregoing points, as deduced from anatomical facts, I consider interesting:—"If (says he) the integument, superficial fascia, and muscles, be removed from the penis and perinæum, we can observe what takes place on the introduction of a catheter. No impediment occurs, during its passage through that part of the tube which corresponds with the corpus spongiosum; for, there it is supported by the body of the penis, and it is also quite straight. But, where it corresponds with the bulb, it is comparatively unsupported, and also slightly dilated at its lower surface. On arriving close to the perineal fascia, should the point of the catheter deviate to either side, or be elevated, or depressed too much, it will miss the foramen, carrying the urethra with it, and so the latter will be pinched between the margin of the foramen and the instrument. If, in such a position of the parts, force be used, or, if the catheter be depressed, with a view to make it correspond with the curves of the urethra, the latter must be torn through, or considerably injured. A catheter, in its construction, resembles an angular lever, though not intended to act as such; but, it virtually becomes such, if, after its process is impeded, and it is thereby rendered fixed, an effort be made to depress the handle; for, then the beak is made to move in the opposite direction, and will readily tear through the urethra. The effect of drawing the penis upwards may be exemplified in this way: when the catheter has reached the bulb (the urethra and perineal fascia being fully exposed), if it deviates to either side, the point will be observed to catch on the margin of the foramen; but, if the urethra is drawn upwards, the impediment will be removed by the widening of the aperture." (See *Quain's Anatomy*, p. 454. ed. 3.) With respect to the opinion, that the direction of the urethra becomes horizontal and its canal straight, when the penis is drawn directly forwards, Dr. Quain states, that, when the penis is so placed, the urethra has to descend nearly an inch, to reach the urethral aperture in the deep perineal fascia, after which it turns somewhat upwards. "Moreover, the part of the urethra, between the root of the penis and the neck of the bladder, will be found loose and relaxed, no matter with what degree of force the penis be drawn forwards; for that will affect only the part of the urethra which corresponds with the body of the organ, as must be evident, when the attachments of the latter to the bones by its suspensory ligament and crura are considered." (*Quain*, *Op*. cit. p. 455.)

Whether the urethra can be made to accommodate itself to a straight instrument, is another question. The urethra is naturally not straight, nor nearly so. If it had been straight, it would have extended in the direction of the bulb in a line, that would pass above the anus to the point of the os coccygis. "Instead of this (asks M. Velpeau) what happens? The urethra gradually disengages itself from the corpus spongiosum and the whole of the bulb, to pass through the deep perineal fascia, enter the pelvis, and terminate at least two inches above the level of the anus, and consequently higher up than the line above specified." (See *Nouv. Elém de Méd. Opér*. t. iii. p. 911.) When, however, the symphysis is short, the prostate not much thickened, the urethra passing through it nearer to its lower than its upper surface, and the pelvis is wide, M. Velpeau alleges, that, extending the penis will efface a good deal of this curve, and allow straight instruments (which on their part also press downwards with more or less force, the bottom of the prostatic portion of the urethra, and the neck of the bladder) to be conveyed without much difficulty into the latter organ. The latter fact we see exemplified every day: the question, whether the curve can be effaced by drawing the penis forwards, is easily settled by an examination instituted in the way proposed by Dr. Quain. For additional observations on the surgical anatomy of the urethra. See URETHRA.

When the catheter is to be introduced with its concavity downwards, or by the "tour de maître," the beak is to be passed into the urethra, and the penis drawn over it, as it were, as in the foregoing method. In other words, the instrument, well oiled, is to be introduced, with its convexity uppermost, as far as it can be, without using force. As soon, however, as the end of the catheter has reached the point at which the canal begins to form a curve under the pubes, the surgeon is to make the penis and the instrument perform a semicircular movement, by inclining them towards the right groin, and then towards the abdomen. In the execution of this manœuvre, care is to be taken to keep the beak of the catheter stationary, so that it may be the centre of the movement, and simply revolve upon itself. This part of the operation, the object of which is to turn the concavity of the catheter upwards, ought to be done very slowly, a large sweep being made with the handle, while particular care is taken not to retract, nor move the beak from its position. The handle is then to be depressed, and the operation finished exactly in the same manner as when the first plan is pursued. As Desault properly observes, the only circumstance, in which the two first methods differ, from the third, is, that in this the same thing is performed by two movements, which is done in the others by one; so that the operation is rendered more complex. No doubt there is great difficulty in keeping the point of the catheter entirely stationary during the semi-circular movement of the handle. Indeed, it is alleged, that, if after laying bare the urethra and the deep perineal fascia in the dead subject, "a catheter be passed down with its concavity turned towards the perineum, we shall find, that, as the turn is being made, the point of the instrument will describe the arch of a circle, carrying the urethra with it round the margin of the urethral foramen," and an impediment will occur, unless the urethra is kept perfectly tense. (See *Quain's Anatomy*, p. 455. ed. 3.) Hence, many judicious surgeons never practise the "tour de maître," except when their patients are corpulent; and, indeed, many of them not then, as they prefer the third method, which is begun with the handle of the catheter, inclined towards the patient's left groin. In treating retention of urine from diseased prostate gland, "I generally find," says an able surgeon, "that I introduce the catheter best by keeping the handle of it at first close to the left groin of the patient. I pass it, as far as possible, in this position; then I bring the handle forwards, nearly at a right angle to the pubes, and not elevating it towards the patient's navel. The next thing is to depress the handle, which is to be done gently and slowly, by placing a single finger on it, and pressing it downwards towards the space between the thighs. In depressing the handle, you generally find the point of the catheter slide into the bladder. Sometimes, however, this does not happen, until you withdraw the stilet; and, in the act of doing this, the introduction of the catheter is completed." In many instances, the operation will be best accomplished by taking care, at the moment when the handle is depressed, to keep the concave surface closely pressed against the arch of the pubes, so that it may turn round it as a centre. (*Brodie on Dis. of Urin. Organs*, p. 145., ed. 2.)

The depth to which the catheter has entered, the cessation of any feeling of resistance to the motions of the beak when revolved upon its axis, and the issue of the urine, are the circumstances by which the surgeon knows, that the instrument has passed into the bladder. In most persons, the signs denoting the entrance of the instrument into the bladder, are sufficiently clear. But, in certain examples, several of them may be absent, and the diagnosis be so obscure as to embarrass the surgeon. Then, if thick mucus, or clots of blood, fill the eyes of the catheter, the urine will not flow. When the bladder is empty, or contracted, the catheter may enter to so inconsiderable a depth, the elevation and depression, and the rotation of it to the right, or left, may be so limited, that doubts may exist about the situation of its beak. A large collection of blood in the anterior half of the bladder may cause deception, as no urine will escape till the catheter has passed completely through it. A catheter has been known to penetrate deeply between the bladder and rectum, and admit of almost as extensive movements, as if it had entered the bladder. A mistake is still more likely to happen, when, in consequence of ulceration of the lower side of the urethra, an accidental pouch has been formed, in front of the rectum, and in the substance of the perineum, as M. Velpeau once noticed in a man who died in the hospital in 1825, and as M. Roux observed in several instances. In fact, such a pouch may be supposed to be a diseased bladder, and this the more readily, as the catheter, directly it passes into it, gives issue to a small quantity of urine. (See *Velpeau, Nouv. Elém. de Méd. Opér*. t. iii. p. 917.)

According to the experience of Desault, the practice of gradually letting out a part of the urine, after the catheter has been introduced, is by no means advantageous. He also disapproves of running into the opposite extreme, that is to say, of letting the urine flow out of the catheter, as fast as it is secreted; for, then, the bladder is kept constantly relaxed, and the detrusor muscle will not be likely to recover its tone. When the bladder is continually empty, it is liable to come into contact with the end of the catheter; a circumstance which has sometimes caused considerable irritation, pain, and even ulceration of that viscus. Besides these inconveniences, there are some others; the catheter is sooner obstructed with mucus, and covered with incrustations, than when it is closed with the stilet. The patients are likewise obliged to remain in bed, where they are either wet with their urine, or compelled to have incessantly a pot for it reception. The best practice, therefore, seems to be that of letting out all the urine, as soon as the catheter is introduced, and then closing the instrument, until the bladder has become moderately distended again; for experience proves, that such moderate distention and relaxation of the muscular fibres of the bladder, alternately kept up, have the same good effects upon that organ, as moderate exercise has upon other parts of the body.

When a catheter is to be left in the urethra, it should always be properly fixed, or else it is apt to slip out, or even pass too far into the passage. For this purpose, some surgeons use cotton thread, which they fasten to the rings, or round the external end of the catheter. The two extremities of the thread are then carried some way along the dorsum of the penis, when they are tied together, and afterwards conveyed in opposite directions round the part, till they meet underneath it, where they are tied in a bow. When a silver catheter is employed, a tape, or narrow riband, is passed through each of the rings, and conveyed to each side of the pelvis, where it is fastened to a circular bandage. Mr. Hunter remarks, that the common bag-truss for the scrotum answers extremely well, when two or three rings are fixed on each side of it along the side of the scrotum, and the ring of the cannula is fastened to any of them with a piece of tape. (*On the Venereal Disease*, ed. 2. p. 159.) He also notices another method: "When the catheter (says he) is fairly in the bladder, the outer end is rather inclined downwards, nearly in a line with the body. To keep it in this position we may take the common strap, or belt part, of a bag-truss, with two thigh straps, either fixed to it, or hooked to it, and coming round each thigh forwards by the side of the scrotum, to be fastened to the belt, where the ends of the bag are usually fixed. A small ring or two may be fixed to each strap just where it passes the scrotum, or root of the penis; and with a piece of small tape, the ends of the catheter may be fixed to those rings, which will keep it in the bladder. It seems Mr. Hunter did not, like Desault, disapprove of leaving the catheter unclosed, and he adds, therefore, a bit of rag, about four or five inches long, with a hole at the end of it, passed over the exterior end of the catheter, and the loose end allowed to hang in a basin, placed between the thighs, will catch the water, which cannot disengage itself from the catheter, and keep the patient dry: or, if another pipe is introduced into the catheter, it will answer the same purpose." (*Op.* cit. p. 191.) The following, which is the French method of retaining the catheter in the bladder, is the most convenient with which I am acquainted: — "A metallic ring, the circumference of which should be more than sufficient to encircle the penis, is to be covered with cloth, and four long pieces of tape, with the same number of short ones, attached to it. This ring, enclosing the penis, is fixed against the pubes by the long pieces of tape, which, surrounding the pelvis in different directions, meet and are tied posteriorly. One of the short pieces is carried through the ring, or round the groove of the catheter, on each side; and being tied to its fellow, fixes the instrument securely in the bladder." (See *Averill's Operative Surgery*, p. 105.) But there are numerous modes of fixing a catheter, which need not be specified; for although they are of importance, the principles which should be observed in adopting them are the main things to be understood. These are, first, never to fix a catheter in such a way, that too much of the instrument projects into the cavity of the bladder; (*Lallemand, Perforation de la Vessie par les Sondes fixés; Revue Méd.* Nov. 1822. p. 299.) and, secondly, to be careful, that the thread, or tape, which is applied, will not irritate or make too much pressure upon the parts.

Mr. Hey has offered some good practical remarks on the introduction of the catheter. If, says he, the point of the catheter be less turned up than the urethra, the point will be pushed against the posterior part of the passage, instead of following the course of the canal. The posterior part of the urethra has nothing contiguous to it which can support it; and no considerable degree of force will push the point of the catheter through that part between the bladder and the rectum. If this accident is avoided, still the point will be pushed against the prostate, and cannot enter the bladder. Mr. Hey tells us, that the truth of this is illustrated, by the assistance which is derived, whenever the catheter stops at the prostate, from elevating the point of the instrument with a finger introduced in the rectum. He notices the impropriety of pushing forwards the point of the catheter, before its handle is sufficiently depressed, as the point would move in a horizontal direction, and be likely to rupture the posterior side of the urethra.

Throughout the writings of Sir Benjamin Brodie on this subject, I find the same caution repeatedly given, not to let the catheter press too much upon the inferior and posterior side of the urethra; and the same thing is insisted upon by the best practical surgeons in France: — "If the end of the catheter were directed too much against the lower side of the urethra," says M. Velpeau, "it would pass with difficulty, and be likely to hitch first in the fossa navicularis, then in the excavation at the bulb, and next in the prostatic depression, and make in one of these situations a false passage. By making the beak keep regularly along the upper side, such accidents will be avoided, unless it be raised too much," &c. He adds, that even this erroneous direction, if not excessive, will be attended with no real inconvenience, except between the crura penis, and the part of the urethra just in front of the symphysis of the pubes. (See *Velpeau, Nouv. Élém. de Méd. Opér.* t. iii. p. 915.) The skill appears to this surgeon, as it did long ago to Hey and Brodie, to consist in guiding the catheter, in the axis of the urethra, from the glans to the bladder, keeping it lightly resting against the dorsal side of the passage. (See also *Malgaigne Man. de Méd. Opér*. p. 650.)

In order to pass the catheter, Mr. Hey places his patient on a bed, in a recumbent posture, his breech advancing to, or projecting a little beyond, the edge of the bed. If the patient's feet cannot rest upon the floor, he supports the right leg by a stool, or by the hand of an assistant. The patient's head and shoulders are elevated by pillows; but the lower part of the abdomen is left in a horizontal position. Mr. Hey commonly introduces the catheter with its convexity towards the abdomen; and having gently pushed down the point of the instrument, till it becomes stopped by the curvature of the urethra, under the symphysis pubis, he turns the handle towards the navel, pressing at the same time its point. In making the turn, he sometimes keeps the handle at the same distance from the patient's abdomen, and sometimes makes it gradually recede; but, in either method, he avoids pushing forwards the point of the catheter any farther, than is necessary to carry it just beyond the angle of the symphysis pubis. When he feels that the point is beyond that part, he pulls the catheter gently towards him, hooking, as it were, the point of the instrument upon the pubes. He then depresses the handle, making it describe a portion of a circle, the centre of which is the angle of the pubis. When the handle of the catheter is brought into a horizontal position, with the concave side of the instrument upwards, he pushes forwards the point, keeping it close to the interior surface of the symphysis pubis; for, when passing in this direction, it will not hitch upon the prostate gland, nor injure the membranous part of the urethra.

If the surgeon uses a flexible gum catheter, it is of great consequence to have the stilet made of some firm metallic substance, and of a proper thickness. Mr. Hey always made use of brass wire for the purpose. If the stilet is too slender, the catheter will not preserve the same curvature during the operation; and it will be difficult to make the point pass upwards behind the symphysis pubis in a proper direction. If the stilet is too thick, it is withdrawn with difficulty.

When the stilet is of a proper thickness, this instrument has one advantage over the silver catheter, which is, that its curvature may be increased while it is in the urethra, which is often of great use, when the point approaches the prostate gland. In all cases where an elastic gum catheter is preferred, care must be taken that it does not pass unnecessarily far into the bladder; and, if it be too long, a part of it ought to be cut off, or a shorter one employed.

When the proper manœuvres with a silver catheter do not succeed, the surgeon must change it, taking a larger or a more slender one, with a greater or less curve, according to such observations as he may have made in his first attempt. But, if the catheter has been of a good form or commodious size, yet has not passed easily, he should, instead of choosing a rigid catheter of another size or form, take a flexible one for his second attempt. The flexible catheter is generally slender, and of sufficient length, and its shape may be accommodated to all occasions, and to all forms of the urethra; for, having a stiff wire, we can give that wire, either before or after it has been passed into the catheter, whatever shape we please; and what is of still greater importance, we can introduce the instrument without or with the wire, as circumstances may require; or what is more advantageous, we can introduce the wire particularly so as not quite to reach the point of the catheter, but only to within two inches or a little more of this part, by which contrivance the point, if previously warmed, and wrought in the hand, has so much elasticity, that it follows the precise curve of the urethra, and yet has sufficient rigidity to surmount any slight resistance. If this too fail, and especially if there be the slightest reason to suspect, that the resistance is not merely spasmodic, but arises from stricture near the neck of the bladder, in a young man, or swelling of the prostate in an old one, we may take a small bougie, turn up the extremity of it with the finger and thumb, so as to make it incline towards the pubes, and, allowing no time for the wax to be softened, pass it quickly down to the obstruction, turn it with a vertical or twisting motion, and make it enter the constricted part. On withdrawing it in about ten minutes or a quarter of an hour, the urine generally escapes, or the catheter may now be introduced. (*John Bell's Principles of Surgery*, vol. ii. p. 215.)

Mr. Hey found, that, in withdrawing the stilet of an elastic gum catheter, the instrument becomes more curved; and he availed himself of this information, by withdrawing the stilet, as he introduced the catheter beyond the arch of the pubes, by which artifice the point was raised in the due direction. He says, you may sometimes, though not always, succeed in introducing an elastic gum catheter, by using one which has acquired a considerable degree of curvature and firmness, by having had a curved stilet kept in it a long while. Introduce this without the stilet, with its concavity towards the abdomen, taking care not to push on the point of the instrument, after it has reached the symphisis pubis, until its handle is depressed into a horizontal position.

Sir Benjamin Brodie, in speaking of retention of urine from diseased prostate gland, advises surgeons to provide themselves with a sufficient number of gum catheters, "mounted not on small flexible straight wires, but on strong iron stilets, having the curve of a silver catheter. The stilets, which belong to the larger gum catheters, should have flattened iron handles, resembling that of a common sound. Like Mr. Hey, he approves of keeping catheters, thus prepared, for a considerable time before they are wanted for use; they will then become fixed in the proper curvature. With the stilet, such a catheter is as inflexible as if it were made of silver; without it, it is capable of retaining its shape to a certain extent, yet it is flexible. Sir B. Brodie always first tries to pass such an instrument. In difficult cases, he admits, that the gum catheter without the stilet will not succeed. He concurs with all experienced surgeons, that, in chronic enlargement of the prostate gland, a catheter, large enough to fill the urethra, without stretching it, is more easy of introduction than a small one; and that the stilet ought to be considerably curved. (*On Dis. of the Urinary Organs*, p. 144. ed. 2.) Speaking of catheters, another excellent modern practitioner remarks, "Elles pénétrent d'autant mieux, toute proportion gardée, que leur volume est plus considérable." (*Velpeau, Nouv. Elém. de Méd. Opér*. t. iii. p. 912.)

When it is necessary to draw off the urine frequently, and the surgeon cannot attend often enough for this purpose, a catheter must be left in the urethra, till an attendant, or the patient himself, has learnt the mode of introducing the instrument.

Mr. Hey imputes the formation of a false passage, or the rupture of the membranous part of the urethra, generally to the method of pushing forwards the catheter, before its handle has been depressed. In this manner, the course of the instrument crosses that of the urethra, and the point of the catheter, pressing against the posterior side of the membranous part of the urethra, is easily forced through the coats of that canal. The want of due curvature in the catheter, and of sufficient bluntness in its point, greatly contributes to facilitate the injury. When it has once happened, the point of the instrument passes more readily into the wound, than along the urethra against the symphysis pubis; and a great deal of skill is requisite to prevent this disadvantageous occurrence from repeatedly taking place, and rendering the case more and more serious.

Mr Hey surmounted a difficulty of this kind, by bending upwards the point of a silver catheter, so as to keep it more closely in contact with the anterior part of the urethra, and thereby pass over the wound made in the posterior side of the canal. In the instance alluded to, as it was necessary to leave an elastic gum catheter in the urethra, Mr. Hey procured some brass wire of a proper thickness, with which he made a stilet; and, having given it the same curvature as that of the silver catheter, he introduced it about four hours after the preceding operation, and fixed it by tying it to a bag-truss. Mr. Hey sometimes succeeded by partly withdrawing the stilet, at the moment when he wished to increase the curvature of the catheter.

In an instance in which the urethra had suffered a violent contusion, Mr. Hey drew off the urine with a silver catheter of unusual thickness, after he had failed with instruments of a smaller bore. He suspected that the urethra was ruptured, and was obliged to raise the point of the catheter by a finger introduced into the rectum, and to use bleeding, purgatives, the warm bath, and opium, before it could be made to pass. The gum catheter was afterwards employed. It is an unsettled point, whether it is best to leave the catheter in the urethra, until the power of expelling the urine has been regained, or to draw off the urine twice a day, and withdraw the catheter after each operation. Mr. Hey thinks, that no general rule can be laid down; some patients cannot bear the catheter to remain introduced; others seem to suffer no inconvenience from it. On the whole, however, he commonly prefers removing the catheter. In this manner, he is of opinion, that the power of expelling the urine again is soonest acquired.

The preceding question is often determined by the nature of the disease; and, as Mr. Hunter observes, in cases of debility of the bladder, and where a catheter passes with difficulty, or with great uncertainty, as well as in other instances, in which it must be used frequently, and for a length of time, it will be necessary to keep it introduced, so as to allow the water to pass freely through it. (*On the Ven. Dis.* edit. 2. p. 191.)

In the majority of retentions of urine from diseased prostate gland, Sir Benjamin Brodie deems it prudent to allow the catheter to remain. "If you remove it, so abundant is the flow of urine, which immediately takes place from the kidneys, that you will find the bladder loaded, and requiring the reintroduction of the catheter, within five or six, perhaps even within three or four hours. It will be necessary to use the catheter again, after another short interval; and it will often happen, when there has been no difficulty in the first introduction of it, that there is considerable difficulty afterwards." (*Brodie, on Dis. of the Urin. Organs*, p. 148. ed. 2.)

In France, a conical silver catheter (*sonde conique*) has sometimes been employed in difficult cases by Boyer, Roux, &c. This instrument has a very slight curvature, and an extremity almost pointed. By force, regularly applied, it is introduced into the bladder in spite of all opposition. Care is taken to keep it in the centre of the passage, and the direction of its point is judged of by the position of the lateral rings. The rule mentioned by Roux, for commencing the great depression of the outer extremity of the instrument, is when, by the finger in the rectum, the point can be felt to have reached the apex of the prostate. (See *Sketches of the Medical Schools of Paris, by J. G. Crosse*, p. 112.) In bad cases, the conical catheter is usually allowed to remain introduced three or four days; and on being withdrawn, a small gum catheter generally admits of being used.

The forcible manner in which the conical silver catheter has been employed, must often do great and dangerous mischief. Thus, in two examples, which were witnessed and examined by M. Roux himself after the decease of the patients, a false passage had been made, no gum catheter could be passed, the urine was effused in the cellular membrane, and the parts were gangrenous. (See p. 116 of the above work.) According to Mr. Crosse, the French surgeons employ the conical silver catheter with too little discrimination, and "in their practice they seem to make no nice distinctions between impediments to the flow of urine from spasm, irritable and inflamed state of the canal, disease of the prostate gland, and cartilaginous stricture of long duration. If the conical catheter be admissible at all, it is in the last of these cases, particularly when combined with fistula in perinæo; and here all surgeons, who are familiar with the treatment of diseases of the urethra, occasionally use means, which approach very closely to the *forcing* method of the French. I have heard of instances, in which John Hunter employed great force with the silver catheter, and overcame the obstruction. I have seen Mr. Pearson (who generally treats strictures as mildly, and, I need hardly say, as successfully, as any man) take a steel sound, and pass it gradually and forcibly on into the bladder, at the same time feeling his way, as it were, by keeping one finger in the rectum: the relief of the patient, and the ultimate cure of the disease, were the results of this practice." (P. 118.) The conical silver catheter has been used by Sir A. Cooper. Without altogether condemning the occasional employment of this instrument, I perfectly coincide with Mr. Crosse, that it is one, with which young men, of little caution and no experience, may do more harm in the first few cases they meet with, than the rest of their life will afford them opportunities of doing good.

Mr. Hunter refers to instances, in which the common catheter had been pushed through the projecting part of the prostate gland into the bladder, and the water then drawn off; but, "in one patient, the blood from the wound passed into the bladder, and increased the quantity of matter in it. The use of the catheter was attempted a second time; but, not succeeding, I was sent for. I passed the catheter till it came to the stop, and then, suspecting that this part of the prostate projected forwards, I introduced my finger into the anus, and found that gland very much enlarged. By depressing the handle of the catheter, which of course raised the point, it passed over the projection; but unfortunately the blood had coagulated in the bladder, which filled up the holes in the catheter, so that I was obliged to withdraw it, and clear it repeatedly. This I practised several days; but, suspecting that the coagulum must in the end kill, I proposed cutting him (the patient) for the stone; but he died before it could be conveniently done, and the dissection, after death, explained the case," &c. (*On the Ven. Dis.* ed. 2. p. 172.)

To a surgeon duly acquainted with anatomy, the introduction of the female catheter is exceedingly simple. From motives of delicacy, the instrument should be passed without any exposure. The surgeon should hold the catheter in his right hand, while he introduces the forefinger of his left hand between the nymphæ, so as to feel upon the upper surface of the passage the little papilla, which surrounds, and denotes to the touch, the precise situation of the orifice of the meatus urinarius. Holding the concavity of the catheter forward, the surgeon, guided by the forefinger of his left hand, is then to introduce the instrument upward into the bladder. A female catheter should always be furnished with some contrivance to prevent its slipping completely into the bladder: the following case, mentioned in a respectable periodical work, fully proves the truth of this remark: —

Some years ago, a surgeon, practising in the country, was required to introduce the catheter for a lady labouring under retention of urine. During the operation he was observed to exhibit signs of confusion, and to quit his patient in considerable embarrassment. The same day he abruptly left his home, and was never seen afterwards. The lady passed several years of dreadful suffering, attributed, by herself and the professional gentleman on whom the treatment of the case devolved, to aggravation of the original complaint. At length an abscess presented itself in the sacral region, and the surgeon punctured it, when his instrument came in contact with some unusually hard substance imbedded in the centre of the abscess. With a pair of forceps, he now extracted, to his utter astonishment, a blackened female catheter. From this period, the lady's sufferings all terminated. A similar accident nearly happened in the practice of another gentleman. (See PROSTATE GLAND; URETHRA; AND URINE, RETENTION OF,)

Medico-Chir. Journ. vol. v. p. 75. Lond. 1818. *J. Hunter*, on the Venereal Disease, ed. 2. in various places. *Hey*'s Practical Obs. in Surgery, ed. 3. *John Bell*'s Principles, vol. ii. Sketches of the Medical Schools of Paris, by *J. G. Crosse*, p. 111. &c. *Jos. M'Sweeny*, Obs. on the Catheter, Edin. Med. and Surg. Journ. No. 58. p. 52. *Richter*'s Anfangsgr. der Wundarzneykunst. *Lallemand*, Perforation de la Vessie par les Sondes fixés, Revue Méd. Nov. 1822. *Langenbeck*, Bibl. für die Chir. b. i. p. 175. 12mo. Gött. 1806. *Desault*, Œuvres Chir. t. iii. *Amussat*, Archives Gén. de Méd. t. iv. *Berton*, Op. cit. Mai. 1826. *Alf. A. L. M. Velpeau*, Nouv. Elém. de Méd. Opér. t. iii. p. 905. 8vo. Paris, 1832. *Quain*'s Elem. of Anatomy, p. 454. 8vo. Lond. 1834. Sir *Benjamin Brodie*, on Dis. of the Urinary Organs, ed. 2. 8vo. Lond. 1835. *J. F. Malgaigne*, Manuel de Méd. Opér. p. 654. 12mo. Paris. 1834.

CATLING, often spelt, in surgical books, *catlin*, is a long, narrow, double-edged, sharp-pointed, straight knife, which is chiefly used in amputations of the leg and forearm, for dividing the interosseous ligaments and the muscles, &c. situated between the two bones.

CAUSTICS. (from καίω, *to burn.*) Medicines, which destroy parts by burning, or chemically decomposing them. The potassa fusa, the potassa cum calce, the antimonium muriatum, the argenti nitras, the hydrargyri nitrico-oxydum, the acidum sulphuricum, and the cupri sulphas, are caustics in frequent use.

CAUTERY. (from καίω, *to burn.*) Cauteries are of two kinds, viz. *actual* and *potential.* By the first term is implied a heated iron; by the second, any caustic application. The high opinion, which the ancients entertained of the efficacy of the actual cautery may be well conceived from the following passage: — "Quoscumque morbos medicamenta non sanant, ferrum sanat; quos ferrum non sanat, ignis sanat; quos vero ignis non sanat, insanabiles existimare oportet." (*Hipp.* sect. 8. aph. 6.) The actual cautery has been employed for the stoppage of bleeding, where the vessels could neither be tied, nor compressed. It has been also employed for the destruction of carcinomatous tumours and ulcers, fistulæ, polypi, and a variety of fungous diseases. Whoever looks over the writings of Hippocrates, will discover, that the actual cautery was a principal means of relief in several chronic affections, as dropsies, diseased joints, &c.

In modern times, the actual cautery has been more and more relinquished, in proportion as surgery has attained a higher state of improvement. On the Continent, however, it still retains advocates. In France, most of the professors recommend and employ it in particular cases. Hospital gangrene, a peculiar disorder, much more frequently seen in foreign and in military hospitals, than in the charitable institutions for the reception of the sick poor in England, is little affected by any internal remedies. "Vegetable and diluted mineral acids are the local means employed with effect in mild cases. I have (says Mr. Crosse) already alluded to a case of Pelletan's, where carbon was applied, and the progress of the disease impeded. But, the actual cautery is the only means, that has been found effectual, in stopping the fatal progress of bad cases of hospital ulcer, and the iron is applied red hot, so as to produce an eschar on every point of the surface of the sore." (See *Sketches of the Medical Schools of Paris*, p. 84. and the article HOSPITAL GANGRENE.)

Desault often employed the actual cautery to destroy fungous tumours of the antrum. (See ANTRUM.) The same practice was followed by Pelletan and other surgeons in France. Mr. Crosse saw it adopted in one such case with good effect. (P. 86.) Part of the fungous was cut away, and the deeper portion, out of the reach of the knife, cauterised. This practice is now generally renounced, and the removal of the whole of the bone, or bones, from which the tumour arises, completed in the manner elsewhere described. (See Bones, Excision of; also Antrum.)

CEPHALOMA. See Cancer and Fungus Hæmatodes.

CERATOTOME. (from *κέρας, a horn,* and *τέμνω, to cut.*) The name given by Wenzel to the knife, with which he divided the cornea.

CERATUM CALAMINÆ. (L.) A good simple dressing.

CERATUM CANTHARIDIS, (L.) formerly used as a dressing for blisters, when it was wished to keep up a discharge from them. On account of the tendency of cantharides to bring on strangury by being absorbed, the ceratum sabinæ is now generally preferred to the cerate of cantharides.

CERATUM CETACEI. (L.) The spermaceti cerate. A mild, unirritating salve, for common purposes.

CERATUM CONII. ℞. *Unguenti Conii* lbj. (See Unguentum.) *Cetacei* ℥ ij. *Ceræ Albæ,* ℥ iij. M. One of the formulæ at St. Bartholomew's Hospital, occasionally applied to cancerous, scrofulous, and phagedænic sores.

CERATUM HYDRARGYRI SUBMURIATIS. ℞. *Hydrarg. Submuriatis,* ʒi. *Cerati Lapid. Calamin.* ℥ ss. M. Some practitioners are partial to this as a dressing for chancres.

CERATUM PLUMBI ACETATIS. (L.) A mild, astringent, unirritating salve.

CERATUM PLUMBI COMPOSITUM. (L.) An excellent, gently astringent salve, for common purposes.

CERATUM SABINÆ. ℞. *Sabinæ foliorum recentium contusorum,* lbj. *Ceræ flavæ,* lbss. *Adipis præparatæ,* lbij. Mix the savin with the melted wax and hog's lard, and strain the composition.

The common application for keeping open blisters, on the plan recommended by Mr. Crowther. (See Blisters.)

CERATUM SAPONIS. ℞. *Plumbi oxydi semivitrei, lib.* j. *Aceti cong.* j. *Saponis unc.* viij. *Olei olivæ, Ceræ flavæ, sing. lib.* j.

The *soap cerate* of St. Bartholomew's Hospital. The three first ingredients are to be mixed together and boiled gently till all the moisture is evaporated; after which, the wax and oil, previously melted together, must be added. The whole composition, from first to last, must be incessantly stirred, without which the whole will be spoiled. This formula was introduced by Pott, as a convenient application to simple fractures.

In applying this cerate, spread on linen, to fractures of the leg or arm, one caution is necessary, namely, that it be in two distinct pieces; for if, in one piece, the limb be encircled by it, and the ends overlap each other, it will form a partial constriction of the fractured part, in consequence of the subsequent tumefaction. (*Pharm. Chirurg.*)

In the North London Hospital, this plaster is not employed, nor indeed is it truly of any essential use.

CERU'MEN AURIS. A degree of deafness is frequently produced by the lodgment of hard dry pellets of this substance in the meatus auditorius. The best plan, in such cases, is to syringe the ear with warm water, which should be injected with moderate force.

In some instances, deafness depends on a defective secretion of the cerumen, and a consequent dryness of the meatus. Here, a drop or two of sweet oil may now and then be introduced into the ear, and fomentations applied.

CHALAZIUM. (from *χάλαζα, a hailstone.*) When the hordeolum or stye does not suppurate, but changes into a hard little tumour, it receives this appellation. (See Hordeolum.)

CHAMOMILE. The flowers are used, in surgery, for making a fomenting decoction.

CHANCRE, (from *καρκῖνος, cancer venereus.*) A sore, arising from the direct application of the venereal poison to any part of the body. Of course it almost always occurs on the genitals. Such venereal sores, as break out from a general contamination of the system, in consequence of absorption, never have the term *chancre* applied to them. (See Venereal Disease.)

CHARPIE is a name, given by the French to a collection of filaments, separated from pieces of old linen rag, four or five inches square, and of loose texture. It is preferred to lint, as absorbing much better. It is of two kinds, the *charpie brute,* and the *charpie râpée.* The *brute* is either fine or coarse; the first being placed in immediate contact with the wound, or ulcer, on account of its softness, and absorbent qualities; the second is employed, as an upper stratum, for purposes of economy. The *râpée,* which is made by scraping fine linen rag, or long charpie with the back of a knife, is more irritating than *charpie brute,* and imbibes the discharge, with greater promptitude. (See *Cutler's Guide in Dressing, and the Methodic Application of Bandages.* 12mo. Lond. 1834.)

CHEMOSIS, (from *χαίνω, to gape.*) When inflammation of the eye is violent, it frequently happens, that lymph, or blood, is effused in the tissue membrane, which connects the conjunctiva with the anterior hemisphere of the eye. Hence, the latter membrane is gradually elevated upon the eyeball, and projects towards the eyelids, so as to conceal within it the cornea, which appears as if it were depressed.

Acute ophthalmy, with chemosis, demands rigorous antiphlogistic treatment. Both general and topical bleeding should be speedily and copiously put in practice, with due regard, however, to the age and strength of the patient. When chemosis is considerable, Scarpa approves of making an incision in the conjunctiva, near its junction with the cornea, for the discharge of the lymph or blood lodged under the distended membrane. In adults, the free exhibition of calomel is also mostly proper. (See Ophthalmy.)

CHEVASTER, or Cheva'stre. A double-headed roller, the middle of which was applied to the chin; the bandage then crossed at the top of the head, and passed on each side to the nape of the neck, where it crossed again. It was next carried up to the top of the head, and so on, till all the roller was exhausted.

CHIA'STRE. A bandage for stopping hemorrhage from the temporal artery. It is double-headed, about an inch and a half wide, and four ells long. Its middle is applied to the opposite side of the head: the bandage is carried round to the bleeding temple, and there made to cross over a compress on the wound. The roller is then continued over the coronal suture, and under the chin, care being taken to make the bandage cross upon the compress. In this way, the rest of it is applied round the head.

CHILBLAINS are the effect of inflammation, arising from cold. A chilblain, in its mildest form, is attended with a moderate redness of the skin, a sensation of heat and itching, and more or less swelling, which symptoms, after a time, spontaneously disappear. The intolerable itching and sense of tingling, accompanying the inflammation of the milder description of chilblains, are observed to be seriously aggravated by exposure to heat. In a more violent degree, the swelling is larger, redder, and sometimes of a dark blue colour; and the heat, itching, and pain, are so excessive, that the patient cannot use the part. In the third degree, small vesicles arise upon the tumour, which burst and leave excoriations. These often change into ill-conditioned sores, which sometimes penetrate even as deeply as the bone, discharge a thin ichorous matter, and generally prove very obstinate. As Dr. John Thomson has remarked, "when the serum contained in the vesications is let out by a small opening, a portion of new cuticle is usually formed to supply the place of that which has been separated; but, when the inflammation is severe, and the affection neglected, or improperly treated, the parts, which are the seat of vesication, are liable to pass into the state of vitiated ulcers. In this state, they yield a thin, ichorous, or sanious discharge, and are in general brought, only after a long time, and with much difficulty, to a healthy suppuration. In neglected cases, these ulcers not unfrequently become covered with foul sloughs. Ulceration often supervenes, and the soft parts, covering the bones, are destroyed." (*On Inflammation*, p. 638.) The worst stage of chilblains is attended with sloughing.

Chilblains are particularly apt to occur in persons, who are in the habit of going immediately to the fire, when they come home in winter with their fingers and toes very cold; they are also frequent in persons, who often go suddenly into the cold, while very warm. Hence, the disease most commonly affects parts of the body, which are peculiarly exposed to these sudden transitions; for instance, the nose, ears, lips, toes, heels, and fingers. Richter remarks, that they are still more frequently occasioned, when the part suddenly exposed to cold, is in a moist perspiring state, as well as warm. Young subjects are much more liable to this troublesome complaint than adults; and females, brought up in a delicate manner, are generally more afflicted than the other sex.

The most likely plan of preventing chilblains is to accustom the skin to moderate friction; to avoid hot rooms and making the parts too warm; to adapt the quantity and kind of clothing to the state of the constitution, so as to avoid extremes, both in summer and winter; to wash the parts frequently with cold water; to take regular exercise in the open air in all kinds of weather; and to take particular care not to go suddenly into a warm room, or very near the fire, out of the cold air.

Although chilblains of the milder kinds are only local inflammations, yet they have some peculiarity in them; for they are not most benefited by the same antiphlogistic applications, which are most effectual in the relief of inflammation in general.

One of the best modes of curing chilblains of the milder kind is to rub them with snow, or ice-cold water, or to bathe them in the latter, several times a day, keeping them immersed each time, till the pain and itching abate. After the parts have been rubbed or bathed in this way, they should be well dried with a towel, and covered with flannel or leather socks.

This plan is perhaps as good a one as any; but it is not that which is always congenial to the feelings and caprice of patients; and with the constitutions of some it may even disagree. In such cases, the parts affected may be rubbed with spirit of wine, linimentum saponis, a mixture of tincture of opium and hartshorn, tinctura myrrhæ, or a strong solution of alum, or vinegar. A mixture of oleum terebinthinæ and balsamum copaivæ, in equal parts, is a celebrated application. A mixture of two parts of camphorated spirit of wine, and one of the liquor plumbi subacetatis has also been praised. Mr. Wardrop speaks highly of one part of the tincture of cantharides, with six of the soap linament. (*Medico-Chir. Trans.* vol. v. p. 142.)

With respect to vesications, "their occurrence is always hastened, and the inflammation, upon which they depend, greatly aggravated by the action of external heat; and, hence, the propriety of continuing cold applications to frost-bitten parts, so long as their temperature continues above the natural standard, or the inflammation excited seems to retain an acute character. From the tendency, which the inflammation excited, has to pass into gangrene, the more stimulating applications, such as spirit of wine, diluted ammonia, or oil of turpentine may be required; but should these applications prove too stimulating, their strength may be lessened by additions of greater or less portions of the linimentum ex aqua calcis." (*Thomson on Inflammation*, p. 648.)

When chilblains suppurate and ulcerate, they require stimulating dressings, such as lint dipped in a mixture of the liquor plumbi subacetatis dilutus, and liquor calcis; tinctura myrrhæ, or warm vinegar. If a salve be employed, one which contains the hydrargyri, nitrico-oxydum, or the unguentum zinci with myrrh, camphor, opium, or the Peruvian balsam, will be found most beneficial. The muriate, or hydrochlorate of lime, in the form of an ointment, has been found by Lisfranc, to be an excellent application to ulcerated chilblains. (*Revue Méd.* Feb. 1826.) Ulcers of this kind frequently require to be touched with the nitrate of silver, or dressed with a solution of it.

Chilblains, attended with sloughing, should be poulticed, till the dead parts are detached. The sores should then be first dressed with some mildly stimulating ointment, such as the unguentum resinæ flavæ, or unguentum zinci. With the first of these, in a day or two, a little of the hydrargyri nitrico-oxydum may be mixed; but the surgeon should not venture on the employment of very irritating applications, till he sees what the parts will bear, and whether such will be requisite at all; for, were he too bold, immediately he leaves off the poultices, he might bring on sloughing again.

Rees's Cyclopædia, art. Chilblains. *Richter*'s Anfangsgr. der Wundarzn. b. 1. *Thomson*'s Lectures on Inflammation, p. 637. &c. *Lassus*, Pathologie Chirurg. t. ii. p. 388, &c. *Callisen*, Systema Chirurgiæ Hodiernæ, vol. i. p. 304. &c. ed. 1798. *Pearson*'s Principles of Surgery, p. 153. &c. ed. 1808. *M. J. Chelius*, Handb. der Chir. b. i. p. 72. Heidelb. 1826.

CHIMNEY-SWEEPERS' CANCER. See Scrotum. (See p.357.)

CHORDEE. (French, from κορδὴ, *a chord.*) When inflammation is not confined merely to the surface of the urethra, but affects the corpus spongiosum, it produces in it an extravasation of coagulable lymph, as in the adhesive inflammation, which, uniting the cells together, destroys the power of distention of the corpus spongiosum urethræ, and makes it unequal in this respect to the corpora cavernosa penis, and therefore a curvature takes place at the time of an erection, which is called a *chordee*. The curvature is generally in the lower part of the penis. When the chordee is violent, the inner membrane of the urethra is so much upon the stretch, that it may be torn, and a profuse bleeding from the urethra excited, that often relieves the patient, and even sometimes proves a cure. This is the *inflammatory* chordee; another kind has been named *spasmodic.*

In the beginning of the inflammatory chordee, bleeding from the arm is often of service; but it is more immediately useful to take blood from the part itself by leeches; for, we often find, that when a vessel gives way, and bleeds a good deal, the patient is greatly relieved. Exposing the penis to the steam of hot water, frequently affords great relief. Poultices have also beneficial effects; and both fomentations and poultices will often do most good when they contain camphor. Opium, given internally, is of singular service; and if it be joined with camphor, the effect will be still greater. Hyosciamus will sometimes agree with the patient better than opium, or even than the acetate, or muriate of morphia; and frequently opium has the best effect, when administered in the form of an enema.

When the chordee continues after all inflammation has terminated, no evacuations are required; for the consequences of the inflammation will gradually cease on the absorption of the extravasated coagulable lymph. Mercurial ointment, rubbed on the part, will promote this event. When the common methods of cure are unavailing, hemlock is sometimes useful. Electricity is said to have been of service. A chordee is often longer in going off than any other consequence of a gonorrhœa, but, in the end, it disappears.

For bringing about the removal of the extravasated lymph, camphorated mercurial ointment is better than the simple unguentum hydrargyri. According to Mr. Hunter, *spasmodic chordee* is benefited by bark. (*On the Venereal Disease*, ed. 2.) The recent leaves of belladonna powdered, and made into an ointment with an equal weight of lard, and rubbed over the penis, are stated to hinder priapism, and relieve chordee more effectually, than any other application hitherto proposed. (*J. A. Paris, in Pharmacologia*, vol. ii. p. 110, ed. 5.)

In the summer of 1828, I attended with Dr. Langmore, of King Street, Finsbury, and Mr. Holt, of Compton Street, Brunswick Square, a gentleman attacked with gonorrhœa, whose case was remarkable on account of the situation and quantity of the effused lymph; for, it occupied the portion of the corpus spongiosum towards the glans, and produced so considerable a swelling, and such pressure on the corresponding portion of the urethra, that the patient required the use of a catheter for nearly a fortnight, as well as the most active antiphlogistic treatment. The irritability of the bladder, without the power of emptying it; the suffering from tenesmus; and the high degree of fever; made this a most severe case.

CICATRIX. A scar: the mark left after the healing of a wound, or ulcer. Also, the new-formed production, or the substance of the cicatrix, which is covered with a very delicate adherent and smooth, shining cuticle, the existence of which is easily demonstrated by means of a blister, or maceration. Under this inorganic stratum is a dense tissue, composed, according to Dupuytren, of fibrous layers, more or less dense, and crossing one another in all directions. Between the *tissue of the cicatrix*, as Dupuytren calls it, and the cuticle, there is no trace of rete mucosum, which circumstance seems to him to explain, why a cicatrix, presents the same colour in the negro and the European, the exceptions being accounted for on principles noticed in the article Burns and Cicatrisation. The tissue of a cicatrix contains neither subaceous follicles, nor hair-bulbs: at all events, this is the case, when the whole thickness of the skin has been destroyed. The same tissue is pierced by a small number of exhalant, or absorbent pores; and, instead of being connected to the subjacent parts by fibro-cellular septa, is bound down to them by a dense laminated substance, so that a depression or hollow is frequently the result.

The appearance, and likewise in some measure the texture of a cicatrix, were observed by Dupuytren, to differ according to the causes, which produced the solution of continuity. The lapse of many years will not prevent a man of experience from distinguishing the cicatrices of burns from those which have been caused by sharp instruments; and both these kinds from others resulting from ulcerated cancer, herpetic diseases, syphilitic sores, or scrofulous abscesses. The importance of this kind of knowledge in medical jurisprudence, is very properly insisted upon by Dupuytren, sometimes to establish the identity of individuals, and sometimes to define the nature of the cause by which the solution of continuity has been produced.

The vascularity of cicatrices is various. In general, they are only furnished with a few very minute capillary ramifications, scarcely capable of being injected. In the face, they are sometimes seen retaining all their whiteness in the midst of the general redness of the countenance occasioned by heat, blushing, &c.; yet they are not insensible to external impressions, and as they are acutely painful, when inflamed, they must receive nerves, though in small number. How sensitive they are with respect to different states of the atmosphere, and how faithfully the painful shootings in them, announce to many individuals, the temperature and moisture of the air, is another point adverted to by Dupuytren, in proof of their having nerves. (See *Clinique Chir.* t. ii. p. 42.)

CICATRISATION. The process by which wounds and sores heal. Granulations having been formed, the next object of nature is to cover them with skin. The parts which had receded by their natural elasticity, in consequence of the breach made in them, now begin to be brought together by the contraction of the granulations. The contraction takes place at every point, but principally from edge to edge, bringing the circumference towards the centre of the sore, which thus becomes smaller and smaller, even although little or no new skin may be formed.

The contracting tendency is in some degree proportioned to the general healing disposition of the sore, and looseness of the parts. When granulations are formed upon a fixed surface, their contraction is mechanically impeded; as, for instance, on the skull, the shin, &c. Hence in all operations on such parts, as much skin as possible should be saved.

For weeks, and, sometimes for months, after the first formation of a cicatrix, its organisation sometimes becomes more and more perfect. Its thickness and strength gradually augment, and its diameter lessens by a consecutive contraction, which only ceases when the cicatrix has become pale and firm, such as it is to remain during the rest of life. This contraction of a cicatrix, exemplified after all suppurating wounds and ulcers, is strongly manifested after burns, and has been taken advantage of to remedy the looseness and redundant length of the skin of certain organs, as of the eyelids, so as to turn the inverted eyelashes from the eyeball. (See *Dupuytren*, *Clin. Chir.* t. ii. p. 41.)

The shape of a sore, as well as its situation, makes also a considerable difference in its readiness to heal: thus, as Sir Astley Cooper has remarked, a sore of a circular form *cæteris paribus*, will be longer in cicatrising, than another of much greater length, but less diameter.

When there has been a loss of substance, making a hollow sore, and the contraction of the granulations has begun, and made a good deal of progress, before they have had time to rise as high as the skin, then the edges of the skin are generally drawn down, and tucked in by it.

The contraction of the granulations continues, till the healing is complete: but it is greatest at first. That there is a mechanical resistance to such contraction, is proved by the assistance, which may be given to the process by the application of a bandage.

Besides the contractile power of the granulations, there is a similar power in the surrounding edge of the cicatrising skin, which assists the contraction of the granulations, and is generally more considerable than that of the granulations themselves, drawing the mouth of the wound together like a purse. The contractile power of the skin is confined principally to the very edge, where it is cicatrising, and, as Hunter believed, to those granulations, which have already cicatrised; for, the natural or original skin, surrounding this edge, does not contract, or at least not nearly so much, as appears by its having been thrown into folds and plaits, while the new skin is smooth and shining.

The uses of the contraction of granulations are various. It facilitates the healing of a sore, as there are two operations going on at the same time, viz. contraction and skinning.

It avoids the formation of much new skin, the advantage of which is evident; for it is with the skin as with all other parts of the body, viz. that such as are originally formed are much fitter for the purposes of life, and less liable to ulceration, than those which are newly formed.

Like all abnormal organic substances (says Dupuytren) cicatrices are readily irritated, and they are destroyed by inflammation with prodigious rapidity. In most cases, a few days, or even a few hours will annihilate the reparative work of several months, and make the solution of continuity as extensive as at first. Frequently however, such destruction does not extend through the whole thickness of the cicatrix. It also merits attention, that a cicatrix is not invaded by exanthematous diseases, such as small-pox, measles, and scarlatina, but continues pale in the middle of the phlogosis of the surrounding parts. (See *Dupuytren*, *Clin. Chir.* t. ii. p. 47.) On the other hand, we know from the details of Lord Anson's voyage, the propensity of scurvy to attack and re-open them.

When the whole surface of a sore has skinned over, the substance, the remains of the granulations on which the new skin is formed, still continues to contract, till hardly any thing more is left than what the new skin stands upon. This is a very small part, in comparison with the first-formed granulations, and it in time loses most of its apparent vessels, becoming white and ligamentous. All newly healed sores are at first redder than the common skin, but in time they become much whiter.

As the granulations contract, the surrounding old skin is stretched to cover the part, which is deprived of skin.

When a sore begins to heal, the surrounding old skin, close to the granulations, becomes smooth, and rounded with a whitish cast, as if covered with something white. This, Mr. Hunter supposed to be a beginning cuticle, and it is as early and sure a symptom of healing as any. While the sore retains its red edge all round, for perhaps a quarter, or half an inch in breadth, we may be certain, that it is not in a healing state.

Skin is a very different substance, with respect to texture, from the granulations upon which it is formed; but it is not known, whether it is a new substance formed by the granulations, or a change in the surface of the granulations themselves.

The new skin most commonly takes its rise from the surrounding old skin, as if elongated from it; but, according to Mr. Hunter, not always. In very large sores, but principally old ulcers, in which the edges of the surrounding skin have but little tendency to contract, and the cellular tissue underneath to yield, or the old skin to become drawn over the ulcerated surface, the nearest granulations do not acquire a cicatrising disposition. In such cases, new skin forms in different parts of the ulcer, standing on the surface of the granulations, like little islands.

This power of the centre of a sore to form new skin, however, is not universally admitted; and, while Sir Astley Cooper acknowledges the fact of insulated portions of skin being sometimes seen in the middle of sores, he maintains, that such appearance is produced in consequence of the whole of the skin not having been destroyed by ulceration, and granulations having arisen from the part of the skin, which was left. This, he says, only happens in irregularly formed sores, where, after the healing process has gone on to the centre, the sore breaks out again at the circumference.

Whatever change the granulations undergo to form new skin, they are generally guided to it by the surrounding skin, which gives this disposition to the surface of the adjoining granulations.

The new-formed skin is never so large as the sore was, on which it is formed, owing to the contraction of the granulations, and the yielding of the surrounding old skin. If the sore is situated where the adjoining skin is loose, as in the scrotum, then the contractile power of the granulations being quite free from obstruction, a very little new skin is formed; but if the sore is situated where the skin is fixed or tense, the new skin is nearly as large as the sore.

The new skin is at first commonly on the same level with the old. This however is not the case with scalds and burns, which frequently heal with a cicatrix higher than the skin, although the granulations may have been kept from rising higher than this part.

The new-formed cutis is neither so yielding, nor so elastic, as the original was; it is also less moveable. It gradually becomes, however, more flexible and loose. At first it is very thin and tender, but it afterwards becomes firmer and thicker. It is a smooth continued skin, not formed with those insensible indentations, which are observed in the natural or original skin, and by which the latter admits of any distention, which the cellular tissue itself will allow of.

This new cutis, and indeed all the substance which had formerly been granulations, is not nearly so strong, nor endowed with such lasting and proper actions, as the originally formed parts. The living principle itself is less active; for when an old sore breaks out, it continues to yield, till almost the whole of the new-formed matter has been absorbed, or has mortified.

The young cutis is extremely full of vessels; but they afterwards disappear, and the part becomes white. Hence, the white appearance of the cicatrices or marks of small-pox.

The surrounding old skin, being drawn toward the centre by the contraction of the granulations, is thrown into loose folds, while the new skin itself seems to be upon the stretch, having a smooth shining appearance.

The new cuticle is more easily formed from the cutis, than the cutis itself from granulations. Every point of the surface of the cutis is concerned in forming cuticle, so that this is forming equally every where at once; but the formation of the cutis is principally, if not entirely, progressive from the adjoining skin.

The new cuticle is at first very thin, and rather pulpy than horny. As it becomes stronger, it looks smooth and shining, and is more transparent than the old cuticle.

The rete mucosum is later in forming than the cuticle, and, in some cases, never forms at all. In blacks who have been wounded, or blistered, the cicatrix is a considerable time before it becomes dark; and in one black, whom Mr. Hunter saw, the scar of a sore, which had been upon his leg when young, remained white when he was old. It is now ascertained, however, that the new skin of a negro does not always become white; but may be at first red, and, after a little time, turn blacker than the original skin. On this point, many interesting observations were made by Dupuytren, and to which I have adverted in the article Burns. From his investigations, it appears, that whether the cicatrix is to be white, or dark coloured, depends upon the injury done to the rete mucosum. If this be entirely destroyed, the scar will be white; but if partially injured, it may become variously coloured, mottled, or even darker than the original skin. (See *Leçons Orales, &c.*, t. i. and ii., art. *Brûlures.*) As the rete mucosum is itself, only an inorganic secretion, produced, according to Breschet, by certain minute glans of the cutis, the differences ascribed by Dupuytren to the various degrees of injury sustained by the rete mucosum itself, will be more correctly referred to the mischief done to those glands, or organs, by which the rete mucosum is formed, or rather to the degree of injury done to the colouring apparatus of the derma, composed of a secreting parenchyma and excretory ducts. (See *M. G. Breschet et M. Rouzel de Vauzeme Sur la Structure de la Peau;* Paris, 1835.) Andral notices, that some cicatrices after having long continued paler than the rest of the skin, have gradually assumed colour, and even become darker than it. In this case (says he) an augmented secretion of colouring matter has followed an unusual activity communicated to the nutritive movement. But, he adds, this darker colour may depend on the capillary circulation being slower. (See *Andral, Précis Anat. Pathol.* t. i. p. 266.) This distinguished pathologist seems then not to have made up his mind upon the point.

Muscle and cartilage are the only two parts of the body incapable of being reproduced in the processes of cicatrisation: when a muscle is divided, it unites by means of a tendinous substance; and, except in very young subjects, the cartilages of the ribs invariably unite with the intervention of bone. Cruveilhier believes, that the reparation of solutions of continuity is not truly the work of the proper texture of the divided organ, but that of the surrounding cellular tissue. Whatever may be the texture injured, whether muscle, nerve, brain, lung, or liver, he observes, that the cicatrix is always fibrous, and the proper texture of the organ never extends into it. Hence he dissents from those physiologists, who think, that the nervous influence can be transmitted through the cicatrices of nerves. He notices the osseous character of the cicatrix in fractures of bones and cartilages; and the disposition of a cicatrix, which is to form part of a cutaneous, or mucous surface, to approach in its character to that of the texture, for which it is to be a substitute. (See *Cruveilhier Anat. Pathol.* t. i. livr. 6. *Maladies des Extrémités.*) The 5th pl. of this livraison gives an interesting view of the state of the muscles, blood-vessels, nerves, &c. in a shoulder stump, a long while after an amputation by Larrey.

Hunter, on the Blood, Inflammation, &c. *Thompson*'s Lectures on Inflammation, p. 399. &c. Sir *Astley Cooper*'s Lectures on Surgery. *M. G. Breschet*, Nouvelles Récherches sur la Structure de la Peau. Paris, 1835. *Dupuytren*, Clin. Chir. t. i. and ii. art. Bruleurs. 8vo. Paris, 1832. *G. Andral*, Précis d'Anat. Pathol. t. i. p. 265. 8vo. Paris, 1829. *J. Cruveilhier*, Anat. Pathologique, t. i. fol. Paris, 1829—1835. livr. vi. pl. 5. An interesting paper on Warty Tumours in Cicatrices, by Mr. Cæsar Hawkins, is contained in Lond. Med. Chir. Trans. vol. xix. 8vo. Lond. 1835.

CICUTA. See Conium.

CINCHONA. As one of the designs of this dictionary is to embrace the subjects of a surgical pharmacopœia, Peruvian bark, which is administered in a great number of surgical cases, cannot be passed over in silence.

Its great repute for stopping mortifications, and accelerating the separation of sloughs, every person, whether of the medical profession or not, has frequently heard of. Indeed, so high is the character of the medicine, that many practitioners order it in some stage, or another, of almost every distemper, often prescribe it when it is totally useless, give it when it actually does harm, and make their patients swallow such quantities as operate perniciously, when smaller doses would effect striking benefit. Some men are credulous enough to think, that from the Peruvian bark vigour and strength are directly extricated, and infused into the constitution, in exact proportion to the quantity of the medicine, which the stomach will keep down and digest.

While a doctrine of this sort prevails, we must expect to see indiscriminate and erroneous practice. The generality of diseases will always be attended with an appearance of languor and weakness, and, certainly, while there exists a supposition that a drug is at hand, possessing the quality of evolving and communicating strength, it would be absurd to fancy, that so important an article will not be largely exhibited in a multiplicity of surgical cases. I shall not presume to hazard an idea of the powers of the Peruvian bark in the practice of physic; but, I have not the least doubt, that they have been unwarrantably exaggerated in surgery, so as to blind and prejudice many a practitioner of good abilities, and lead him to adopt injudicious and hurtful methods of treatment.

Under particular circumstances, bark has undoubtedly the quality of increasing the tone of the digestive organs; and, of course, whenever the indication is to strengthen the system by nourishing food, and the appetite fails, this medicine may prove of the highest utility, provided it be given in moderate doses, and it be found to agree with the stomach and bowels. But, the plan of making the patient swallow as much of it as can be got into his stomach, must, in my opinion be invariably followed by bad, instead of good, effects. How can it be reasonably expected, that the stomach, which is already out of order, can be set right by having an immoderate quantity of any drug whatever forced into it? In fact, if the alimentary canal were in a healthy state, must not such practice be likely to throw it into a disordered condition?

Bark is an excellent medicine, when judiciously administered; but, like every other good medicine, in bad hands, it may be the means of producing the worst consequences. How much good does mercury effect in an infinite nubmer of surgical diseases, when prescribed by a surgeon of understanding; what a poison it becomes under the direction of an ignorant practitioner! With respect to cases of mortification, bark is often most strongly indicated, when the sloughing is not surrounded with active inflammation, when the patient is debilitated, and his stomach cannot take nutritious food. I have always regarded the notion of giving bark, as a specific for gangrene, as totally unfounded and absurd. I have watched its effects in these cases, and could never discern, that it had any peculiar power of operating directly upon the parts, which are distempered. Whatever good it does, is by its improving the tone of the digestive organs, and making them more capable of conveying nourishment, and, of course, strength into the constitution.

I should feel guilty of a degree of presumption in speaking thus freely upon this subject, were not my sentiments in some measure supported by those of certain surgical writers, the remembrance of whom will always be hailed with unfeigned veneration and esteem. Mr. Samuel Sharp was not bigoted to bark; and, while he allowed it to possess a share of efficacy, he would not admit, that it was capable of miraculously accomplishing every thing, which the ignorant or prejudiced alleged. "I know," says he, "it will be looked upon by many as a kind of scepticism, to doubt the efficacy of a remedy, so well attested by such an infinity of cases; and, yet, I shall frankly own, I have never clearly to my satisfaction, met with any evident proofs of its preference to the cordial medicines usually prescribed; though I have a long time made experiment of it with a view to search into the truth.

"Perhaps, it may seem strange, thus to dispute a doctrine established on what is called matter of fact; but, I shall here observe, that in the practice of physic and surgery, it is often exceedingly difficult to ascertain a fact. Prejudice, or want of abilities, sometimes misleads us in our judgment, where there is evidently a right and a wrong; but, in certain cases, to distinguish how far the remedy, and how far nature operates, is probably above our discernment. In gangrenes, particularly, there is frequently such a complication of unknown circumstances, as cannot but tend to deceive an unwary observer. Mortifications arising from mere cold, compression, or stricture, generally cease upon removing the cause, and are, therefore, seldom proper cases for proving the power of the bark. However, there are two kinds of gangrene, where internals have a fairer trial; those are a spreading gangrene from an internal cause, and a spreading gangrene from violent external accidents, such as gunshot wounds, compound fractures, &c. Yet, even here we cannot judge of their effect with absolute certainty; for, sometimes, a mortification from internal causes is a kind of critical disorder. There seems to be a certain portion of the body destined to perish, and no more; of this we have an infinity of examples brought into our hospitals, where the gangrene stops at a particular point, without the least assistance from art. The same thing happens in the other species of gangrene from violent accidents, where the injury appears to be communicated to a certain distance, and no farther; though, by the way, I shall remark in this place, contrary to the received opinion, that gangrenes from these accidents (where there has been no previous straitness of bandage) are as often fatal, as those from internal causes.

"As I have here stated the fact, we see how difficult it is to ascertain the real efficacy of this medicine; but, had bark in any degree those wonderful effects in gangrenes, which it has in periodical complaints, its pre-eminence would no more be doubted in the one case, than in the other. What, in my judgment, seems to have raised its character so high, are the great numbers of single observations published on this subject, the authors of which, not having frequent opportunities of seeing the issue of this disorder, under the use of cordials, &c. and some of them, perhaps, prejudiced with the common supposition, that every gangrene is of itself mortal, have therefore ascribed a marvellous influence to the bark, when the event has proved successful." (*Sharp's Crit. Inq.* chap. viii. *on Amputation.*)

Some further remarks on this subject will be reserved for the article Mortification.

Bark is given so extensively in the practice of surgery, that there are few important cases, in which, in certain circumstances, and at some period or another, it is not indicated. When persons have been weakened by a course of mercury, or by the effects of any disease whatsoever; moderate doses of bark will frequently be found of great service. But, it only becomes so on the principles above suggested, and, so far as my judgment extends, this medicine should never be prescribed in any surgical cases in excessive and unreasonable quantities.

One desirable result of the complete establishment of the modern doctrine, that the virtues of the various kinds of cinchona reside in two salifiable bases, or alkaline elements, termed *cinchonia*, and *quinia*, is that of being able to prescribe preparations, which will concentrate all the efficacy of the medicine in formulæ of moderate bulk, not likely at least to disorder the alimentary canal by the mechanical effects of quantity.

The sulphate of quinine or quinia, "appears to be the most efficient of all the salts of bark. We must be careful not to combine it with substances that form insoluble compounds with it. The infusum rosæ comp. is objectionable as a vehicle, on account of the astringent matter which it contains, and which therefore precipitates the quinia from its solution." The form, in which Dr. Paris prefers to prescribe it, is that of solution, with a minim of sulphuric acid to every grain of the salt. (*Pharmacologia*, vol. ii. p. 163.) It is frequently made into pills, with the conserve of roses, or joined with hyosciamus, squills, opium, and other medicines. Professor Brande does not agree with Dr. Paris, respecting the compound infusion of roses being an unfit vehicle for sulphate of quinine, and recommends the subjoined formula: ℞. Quiniæ sulphatis gr. ij. Infus. rosæ comp. ʒxi. Tinct. cort. aurant. syrupi ejusdem āā ʒss. M. ft. haustus bis in die sumendus.

"Although the pale bark yields chiefly *cinchonia*, with a small quantity of quinia, and the yellow *quinia*, with a small proportion of cinchonia, yet the quantities of the opposite principles are too small to give a character to the medical properties, or the chemical nature of the barks. In the red bark of the pharmacopœias, these salts exist together in nearly equal proportions." (See *Thomson's Elements of Materia Med.* p. 489. ed. 2.)

CINNABAR ARTIFICIAL (*Hydrargyri sulphuretum rubrum*), is chiefly employed by surgeons for fumigating venereal ulcers. An apparatus is sold in the shops for this purpose. The powder is thrown upon a heated iron, and the smoke is conducted by means of a tube to the part affected. For this it is an inferior preparation to the grey oxide.

CIRCUMCISION, (from *circumcido*, to cut round). The operation of cutting off a circular piece of the prepuce. (See Phymosis.)

CIRSOCELE, (from κιρσὸς, a varix, and κήλη, a tumour.) Cirsocele a varicose enlargement of the spermatic vein. See *Varicocele.*

CIRSOPHTHALMIA, (from κιρσὸς, a varix, and ὀφθαλμὸς the eye.) A general varicose affection of the eye.

CLAP. (See Gonorrhœa.)

CLOACA. The openings leading through the new bony shell, in cases of necrosis, down to the enclosed dead bone are termed *cloacæ.*

COLLYRIUM ALUMINIS. ℞. Aluminis purif. gr. xii. ℈j. Aq. rosæ, ℥vj. Misce.

COLLYRIUM CUPRI SULPHATIS CAMPHORATUM. ℞. Aq. cupri sulphatis camphoratæ, ʒij. Aq. distillatæ, ℥iv. M. Recommended by the late Mr. Ware, for the purulent ophthalmy of children.

COLLYRIUM HYDRARGYRI OXYMURIATIS. ℞. Hydrarg. oxymuriatis, gr. ss. Aq. distillat. ℥iv. M. This collyrium is sometimes employed, after the acute stage of opthalmy has subsided, and it will disperse many superficial opacities of the cornea.

COLLYRIUM OPIATUM. ℞. Opii Extracti gr. x. Camphoræ gr. vj. Aquæ distillatæ ferventis, ℥xii. Beat the two first ingredients together in a mortar, and mix the hot water gradually, and strain the fluid. (See *Wilson's Pharm. Chir.* p. 70.)

COLLYRIUM PLUMBI ACETATIS.— ℞. Aquæ rosæ, ℥vj. Plumbi acetatis, ℈j. Misce: or, ℞. Aq. distillatæ, ℥iv. Liq. plumbi acetatis gutt. x. M.

COLLYRIUM ZINCI SULPHATIS.— Zinci sulphatis, gr. v. Aq. distillatæ, ℥.iv. M. It may be made gradually stronger.

COLLYRIUM ZINCI SULPHATIS CUM MUCILAGINE SEMINIS CYDONII MALI. ℞. Aq. plantaginis, ℥iv. zinci sulphatis, gr. v. et mucil. sem. cydon. mal. ℥ss. M. In order to check the morbid secretion from the eyelids, in cases of fistula lachrymalis, or what Scarpa calls *il flusso palpebrale puriforme*, this celebrated Professor recommends a few drops of the above collyrium to be insinuated between the eyelids and the eye.

COLPOCELE, (from κόλπος, the vagina, and κήλη, a tumour.) A tumour or hernia, situated in the vagina.

COLPOPTOSIS, (from κόλπος, the vagina, and πίπτω, to fall down.) A bearing or falling down of the vagina. (See Vagina, Prolapsus of.)

COMPRESS, (from *comprimo*, to press upon.) Folded linen, lint, or other materials, making a sort of pad, which surgeons place over those parts of the body on which they wish to make particular pressure; and for this purpose a bandage is usually applied over the compress. Compresses are termed *graduated*, when of a conical form, and the apex is so applied, as to make the pressure act very particularly on a certain point.

COMPRESSION OF THE BRAIN. (See Head, Injuries of.)

CONCUSSION OF THE BRAIN. (See Head, Injuries of.)

CONDYLOMA, (from κόνδυλος, a tubercle, or knot.) The term is generally applied to an excrescence of a hard warty description about the anus. The practitioner may either destroy it with caustic, tie its base with a ligature, or remove it at once with a knife: the first is generally the worst; the last the best and most speedy method.

CONIUM MACULATUM. Hemlock.— *Cicuta.* This is a medicine to which my observations in practice incline me to impute considerable efficacy. However, there is no doubt that, when it is represented as a certain cure for cancer and scrofula, exaggeration is employed. It is an excellent remedy for irritable painful sores of the scrofulous kind, and it will complete the cure of many ulcers in which the venereal action has been destroyed by mercury, though the healing does not proceed in a favourable way. Hemlock is likewise beneficial to several inveterate malignant sores, particularly, some which are every now and then met with upon the tongue. It is an eligible alterative in cases of noli me tangere, porrigo, and various herpetic affections. I have seen several enlargements of the female breast give way to hemlock conjoined with calomel. Some swellings of the testes also yield to the same medicines. Hemlock certainly has not the power of curing cancer; but its narcotic anodyne qualities tend to lessen the pain of that distemper, so as to render it by no means a contemptible remedy in that intractable kind of case.

Respecting hemlock, Mr. Pearson observes, that the extract and powder may be sometimes given with evidently good effect in spreading irritable sores; whether they are connected with the active state of the venereal virus, or whether they remain after the completion of the mercurial course; and it would seem, that the benefit, conferred by this drug, ought not to be ascribed solely to its anodyne qualities, since the same advantages cannot always be obtained by the liberal exhibition of opium, even where it does not disagree with the stomach. He states, that cicuta is almost a specific for the the venereal ulcers, which attack the toes at their line of junction with the foot, and which frequently become gangrenous. Also in spreading sores, which are accompanied with great pain, and no appearance of remarkable debility, hemlock will often do more than bark, diluted sulphuric acid, or cordials. The common mode of exhibiting hemlock is in the form of pills, made of the extractum conii, five grains to each. However, I have always thought three grains sufficient to begin with, the dose being afterwards gradually augmented. It is curious how large a quantity may at last be taken in this manner. Mr. J. Wilson, in his Pharmacopœia Chirurgica, informs us of a remarkable case of cancerous ulcer, for which the patient took a hundred and twenty pills, each consisting of five grains of the extractum conii, in twenty-four hours, and this without any benefit being produced, or any inconvenience to the patient.

The stomach being a little disordered, and the head somewhat giddy, is a sign of the dose being sufficiently strong.

"According to some writers, but more particularly Dr. Withering, there are several ways, in which the views of a medical practitioner, in prescribing this remedy, may be frustrated. The plant chosen for preparing the extract may not be the true *conium maculatum*, which is distinguished by red spots along the stalk. It may not be gathered when in perfection, namely, when beginning to flower. The inspissation of the juice may not have been performed in a water-bath, but, for the sake of despatch, over a common fire. The leaves, of which the powder is made, may not have been cautiously dried and preserved in a well-stopped bottle; or if so, may still not have been guarded from the ill effects of exposure to light. Or, lastly, the whole medicine may have suffered from the mere effects of long keeping. From any of these causes, it is evident, the powers of cicuta may have suffered; and it happens, no doubt, very frequently, that the failure of it ought, in fact, to be attributed to one or other of them." (*Pharmacopœia Chirurgica, published in* 1802. p. 174.)

The activity of hemlock is now found to reside in a resinous element, termed conia, obtained separately, by evaporating an ethereal tincture of the leaves on the surface of water. A dose of half a grain will produce vertigo and headach. The watery extract of this plant has been proved by Orfila to have but little power. (*J. A. Paris, in Pharmacologia*, vol. ii. p. 180. ed. 6.) According to Professor A. T. Thomson, the extract is an objectionable preparation owing to the difficulty of preserving it. The best, he says, is the tincture of the Edinburgh and Dublin Colleges. (See *Thomson's Elements of Materia Medica*, p. 429. ed. 2.)

I have sometimes prescribed as an alterative, with manifest benefit in several surgical diseases, a pill containing three grains of extractum conii, or, what is preferable, the dried leaves, one of hydrargyri submurias (calomel), and one of antimonii sulphuretum præcipitatum. In various cases of scrofulous diseases, and also in several very painful irritable ulcers and swellings, it is occasionally applied in the form of fomentations, lotions, and poultices. The latter are generally made by mixing the powder with the common bread and water cataplasm: the lotions, by dissolving ʒ ij. or ʒ iv. of the extract in ℥ viij. of water.

F. Hoffinan, of Hemlock, 8vo. Lond. 1763. *A. Storck*, Libellus, quo demonstratur cicutam non solum usu interno tutissimè exhiberi, sed et esse simul remedium valdè utile, &c.; editio altera, 8vo. Vindob. 1761. Also Supplementum Necessarium de Cicuta, 8vo. Vindob. 1761. *J. Pearson*, On various Articles of the Materia Medica, &c. 2d ed. 8vo. London, 1807. *J. A. Paris*, Pharmacologia, ed. 6. *A. T. Thomson*, Elem of Mat. Med. p. 425. &c. ed. 2. 8vo. Lond. 1835.

CONJUNCTIVA, GRANULAR. The following account of the subject is given by Dr. Frick: This disease is mostly the sequel of purulent ophthalmy. It is characterised by a rough, scabrous, or granulated state of the palpebral conjunctiva, with a gleety or puriform discharge from its surface. The constant friction of the eyelids upon the globe brings on a varicose state of the sclerotic conjunctiva, and a dusky appearance of the cornea. The patient complains of a sensation similar to that produced by sand or other extraneous matter, under the eyelids; the eye cannot endure the light; and there is a troublesome epiphora. In the recent stage, a cure is easily accomplished by the application of a few leeches to the eyebrows, and pencilling the part once or twice a day with the vinous tincture of opium, or the ung. hydrarg. nitrat. When these means fail, the sulphate of copper, or nitrate of silver, may be used; though not so freely as to produce a slough, but only to change the diseased condition of the part. (See *Frick on Dis. of the Eye*, p. 240. ed. 2.) Mr. R. Welbank recommends the use of these means to be followed by ablution with tepid water, and the application of a few leeches. He also recommends counter-irritation and active aperients. The upper eyelid, he says, should be completely everted in examination, as there is sometimes at the angle, where the conjunctiva passes from the globe to the lid, a crescentic fringed fold, not unlike a cock's comb, apt to keep up a tedious inflammation of the cornea. Dr. Frick considers excision of the granular surface proper only when it is hard, insensible, and prominent, or the excrescences hang like peduncles from the surface of the eyelids. In this state, Dr. Vetch recommends the application of a little burnt alum, or verdigris, and then washing it off with a syringe. (See the article CORNEA.)

CONTUSED WOUNDS. (See WOUNDS.)

CONTUSION. (from *contundo*, to bruise.) A bruise. Slight bruises seldom meet with much attention; but when they are severe, very bad consequences may ensue, and these are the more likely to occur when the accidents are not taken proper care of.

In all severe bruises, besides the inflammation which the violence necessarily occasions, there is an instantaneous extravasation of blood in the cellular tissue, in consequence of the rupture of many of the small vessels of the part. In no other way, can we account for those very considerable tumours, which often rise immediately after injuries of this nature. The black and blue appearance, instantly following many bruises, can only be explained by there being an actual effusion of blood from the small arteries and veins, which have been ruptured. Even largish vessels are frequently burst in this manner, and considerable collections of blood are the consequence. Blows on the head often cause a large effusion of blood under the scalp, and sometimes a smaller extravasation under the aponeurosis of the occipito-frontalis muscle. I have attended cases, in which more than a pint of blood was effused in the former of these places. The most copious extravasations on the head, indeed, are generally directly under the scalp, where the larger branches of the temporal, occipital, and frontal arteries are situated. I attended a man in the King's Bench, over whose sacrum an extravasation of three quarts of blood took place from a severe contusion, and, in the North London Hospital there is now (January 1837) a man who, in consequence of being jammed between the side of the Regent's Canal and a barge, sustained a fracture of the right thigh, a laceration of the scrotum with protrusion of the testes and an extravasation of several pints of blood under the left glutæal region.

Besides the rupture of an infinite number of small vessels, and an extravasation of blood, which attend all bruises in a greater or less degree, the tone of the fibres and vessels, which have suffered contusion, is considerably disordered. Nay, the violence may have been so great, that the parts are from the first deprived of vitality, and must slough.

Parts at some distance from such as are actually struck, may suffer greatly from the violence of the contusion. This effect is what the French have named a *contrecoup*.

The bad consequences of bruises are not invariably proportioned to the force which has operated; much depends on the nature and situation of the part. When a contusion takes place on a bone, which is thinly covered with soft parts, the latter always suffer very severely, in consequence of being pressed, at the time of the accident, between two hard bodies. Hence, bruises of the shins frequently cause sloughing and troublesome sores. Contusions affecting the large joints are always serious cases; the inflammation occasioned is generally obstinate, and abscesses and other diseases, which may follow, are proper grounds for serious alarm.

The species of mischief, resulting from what are termed wind contusions, is noticed in the article GUNSHOT WOUNDS.

In the treatment of bruises, three indications present themselves. The first is to prevent and diminish the inflammation, which from the violence done, must be expected to arise. The bruised parts should be kept perfectly at rest; and either be fomented, or covered with linen constantly wet, with the liquor plumbi acetatis dilutus, or the lotio ammon. acetatis. When muscles are bruised, they are to be kept in a relaxed position, and as quiet as possible.

If the bruise be violent, it will be proper to apply leeches, and this repeatedly; and even in some cases, particularly when joints are contused, to take blood from the arm. In every instance, the bowels should be kept well open with calomel and saline purgatives.

A second indication is to promote the absorption of the extravasated fluid by discutient applications. These may at once be employed in all ordinary contusions, not attended with too much violence; for then nothing is so beneficial as maintaining a continual evaporation from the bruised part, by means of the cold saturnine lotion, and, at the same time, repeatedly applying leeches. In common bruises, however, the *lotio ammoniæ muriatæ* (see *this article*) is an excellent discutient application; but most surgeons are in the habit of ordering liniments for all ordinary contusions, and as these applications prove serviceable in accelerating the absorption of the extravasated blood, the practice is highly praiseworthy. The linimentum saponis, or the linimentum camphoræ, is as good as any that can be employed. (See LINIMENTUM.)

In many cases, unattended with any threatening appearances of inflammation, but in which there is a good deal of blood and fluid extravasated, bandages act very beneficially, by the remarkable power which they have of exciting the action of the lymphatics, by means of the pressure which they produce.

A third indication is to restore the tone of the parts. Rubbing the parts with liniments has a good deal of effect in this way. But, notwithstanding such applications, it is often observed, that bruised parts continue for a long while weak, and even swell, and become œdematous, when the patient takes exercise, or allows them to hang down, as their functions in life may require. Pumping cold water, two or three times a day, on a part thus circumstanced, is the very best measure which can be adopted. A bandage should also be worn, if the situation of the part will permit. These steps, together with perseverance in the use of liniments, and in exercise gradually increased, will soon bring every thing into its natural state again.

When blood is extravasated under the skin in large quantity, so as to form a considerable tumour, the best practice is generally to avoid making any opening for its discharge. The opening would not procure the evacuation of a great part of it; if internal bleeding were going on, it would encourage it; and the air having access to the blood remaining behind, would certainly be followed by its putrefaction. Hence, irritation, suppuration, and sloughing. In the greater number of instances, collections of blood under the skin, from contusions, are quietly, though sometimes slowly, absorbed; and the kinds of mischief, here specified, are thus avoided. In the two remarkable cases, which I have adverted to in the North London Hospital and King's Bench Infirmary, this observation was well illustrated.

COPPER. The subacetate and sulphate are used in surgery. The first, often called ærugo, or prepared verdigris, is employed as an escharotic. Mixed with an equal quantity of powdered cantharides, it is sometimes applied for the removal of warts and other excrescences. At present, the old practice of destroying the surface of chancres with the view of hindering the absorption of venereal matter, and rendering the exhibition of mercury needless, is not attempted with sulphate of copper, but occasionally with nitrate of silver.

CORNEA. (from *cornu*, a horn.) The anterior transparent convex part of the eye, which in texture is tough like horn. It has a structure peculiar to itself, being composed of a number of concentric cellular lamellæ, in the cells of which is deposited a particular sort of fluid. It is covered externally by a continuation of the conjunctiva, which belongs to the class of mucous membranes; and it is lined by a membrane, the tunica humoris aquei, which belongs to the serous class.

Fleshy Excrescences of the Cornea.

Mr. Wardrop, in his Essays on the Morbid Anatomy of the Human Eye, has published an excellent chapter on this subject. Besides pterygia, which are treated of in another part of this dictionary, Mr. Wardrop states, that the cornea is subject to two kinds of caruncles, or fleshy excrescences. One appears at birth, or soon after it, and resembles the nævi materni so frequent on the skin of various parts of the body. The second is described, as having a greater analogy to the fungi which grow from mucous surfaces, and being in general preceded by ulceration.

Of the congenital excrescence of the cornea, Mr. Wardrop has seen two remarkable instances. The first was in a girl, eight or ten years of age, on whose left eye there was a conical mass, the base of which grew from about two-thirds of the cornea, and a small portion of the adjoining sclerotic coat.

The second example occurred in a patient upwards of fifty years old. The tumour had been observed from birth, was about as large as a horse-bean, and only a small portion of it seemed to grow from the cornea. The other part was situated on the white of the eye, next the temporal angle of the orbit. From the middle of the excrescence, upwards of twelve long firm hairs grew, and hung over the cheek.

Mr. Wardrop acquaints us, that a similar tumour, with two hairs growing out of it, was seen at Lisbon by Dr. Barron, of St. Andrew's. Mr. Crampton also mentions, that he once saw a "tuft of very strong hairs proceeding from the sclerotica." (*Essay on the Entropeon*, p. 7.) And De Gazelles met with an instance, in which a single hair grew from the cornea. (*Journ. de Médecine*, t. xxiv.) According to Mr. Wardrop, this species of excrescence of the cornea greatly resembles the spots, covered with hair, which are frequent on various parts of the surface of the body.

With regard to the second kind of tumour growing from the cornea, a fungus, proceeding from an ulcer of this part of the eye, is stated to be very uncommon. However, it is said, that when a portion of the iris protrudes through an ulcer of the cornea, the growth of a large excrescence from the projecting part is not so unusual. Of such a disease, Mr. Wardrop has cited examples from *Maître Jean's Traité des Maladies des Yeux*. Excrescences, growing from the cornea, are also quoted from the following works: — *Handbuch der Pathologischen Anatomie, von F. G. Voigtel*, Halle, 1804. *Praktische Beobachtungen über den grauen Staar und die Krankheiten der Hornhaut, von Joseph Beer*, Wien, 1791. *Plaichner's Dissertatio de Fungo Oculi.* (See *Wardrop's Essays on the Morbid Anatomy of the Human Eye*, vol. i. chap. 4.) Others are likewise described by *Mery, in Mém. de l'Acad. des Sciences*, 1703; by *Dupré, in Phil. Trans.* vol. xix.; and *Home, in the same work*, vol. lxxxi.

The only treatment which excrescences of the cornea admit of, is that of removing them with a scalpel and a pair of forceps, or destroying them with caustic.

Abscesses of the Cornea.

When the matter is collected between the lamellæ of the cornea, it first appears like a small spot; and, instead of resembling a speck in colour, it is of the yellow hue of common pus. As the quantity of the matter increases, this spot becomes broader, and it does not alter its situation from the position of the head. If it be situated among the external layers of the cornea, or immediately below the corneal conjunctiva, a tumour is formed anteriorly, and, if touched with the point of a probe, the contained fluid can be felt fluctuating within, or if the eye be looked at sideways, an alteration in the form of the cornea may be readily perceived.

When the matter collects between the interior lamellæ, it does not produce any evident alteration in the external form of the cornea; but, if it be touched with the point of a probe, a fluctuation can be more or less distinctly perceived, and the spot alters its form, and becomes somewhat broader.

Such collections of matter appear on every part of the cornea. Sometimes they alter their situation by degrees, and sink downwards; and sometimes they change both their situation and form. They seldom cover more than one-fourth, or one-third of the cornea.

When the quantity of matter is small, it is often completely absorbed during the abatement of the inflammatory symptoms, and it generally leaves no vestige behind it. In other cases, the cornea is eroded externally, producing an ulcer, and subsequent opacity. In some few instances, the internal lamellæ of the cornea give way, and the matter escapes into the anterior chamber. When an artificial opening is made, the matter often does not readily flow out; and it is sometimes so tenacious, and contained in a cavity so irregular, that it neither escapes spontaneously, nor can it be evacuated by art.

It is particularly to the cases, in which the matter collects between the layers of the cornea, that the terms unguis, and onyx, are applied. (See *Wardrop's Essays on the Morbid Anatomy of the Human Eye*, vol. i. chap. 6.) According to a late writer, these words should be restricted to what he names "crescentic interlamellar depositions." (*Travers's Synopsis of the Diseases of the Eye*, p. 115.) Where the cornea is affected with onyx, this gentleman commends antiphlogistic treatment. (P. 278.) And with respect to a large collection of matter in the cornea, whether the puriform onyx, or central abscess, he observes, that it requires "a supporting constitutional treatment, mild cathartics, and the application of blisters: calomel should be avoided, and the cornea can seldom be punctured with advantage." (P. 280.)

Opacities of the Cornea.

Opacity of the cornea is one of the worst consequences of obstinate chronic ophthalmy. The term *opacity* is used, when the loss of transparency extends over the whole, or the greater part of the cornea: while other cases of a more limited kind are named *specks*. The distinction, as Beer observes, is chiefly important in respect to the prognosis. (*Lehre von den Augenkr.* b. ii. p. 77. *Ryall in Dubl. Trans.* vol. v. p. 9.)

Scarpa distinguishes the superficial and recent species of opacity from the *albugo* and *leucoma* (see these words), which are not in general attended with inflammation, assume a clear pearl colour, affect the very substance of the cornea, and form dense specks. The *nebula*, or slight opacity, allows the iris and pupil to be discerned through a kind of cloudiness, and consequently does not entirely bereave the patient of vision. The nebula (he says) is an effect of protracted or ill-treated chronic ophthalmy. The veins of the conjunctiva, much relaxed by the long continuance of the inflammation, become preternaturally turgid and prominent; afterwards they begin to appear irregular and knotty, first in their trunks, then in their ramifications, near the union of the cornea with the sclerotica, and lastly, in their most minute ramifications, returning from the delicate layer of the conjunctiva, spread over the cornea.

When this happens, some reddish streaks begin to be perceptible, in the interspaces of which, very soon afterwards, a thin milky albuminous fluid is effused, which dims the diaphanous state of the cornea. The whitish, delicate, superficial speck, thence resulting, forms precisely what is termed *nebula*, or the kind of opacity here to be considered. And since this extravasation may happen only at one point of the cornea, or in more places, the opacity may be in one speck, or in several distinct ones, but which altogether diminish, more or less, the transparency of this membrane.

The opacity of the cornea, which sometimes takes place in violent acute ophthalmy, seems to Scarpa to be quite different from *nebula*. The first is a deep extravasation of coagulable lymph in the internal cellular texture of the cornea, or else the opacity proceeds from an abscess between the layers of this membrane about to end in ulceration. On the other hand, the nebula forms slowly upon the superficies of the cornea, in long-protracted chronic ophthalmy; is preceded first by a varicose enlargement of the veins in the conjunctiva, next of those in the delicate lamina of this tunic, continued over the front of the cornea; and finally it is followed by an effusion of albuminous lymph in the texture of this thin layer, expanded over the transparent part of the eye. This effusion never elevates itself in the shape of a pustule. Wherever the cornea is affected with *nebula*, the part of the conjunctiva, corresponding to it, is constantly occupied by a network of varicose veins, more knotty and prominent than other vessels of the same description; and though the cornea be clouded at more points than one, there are distinct corresponding fasciculi of varicose veins in the white of the eye. Scarpa injected an eye affected with chronic ophthalmy, and *nebula*, and he found that the wax easily passed, both into the enlarged veins of the conjunctiva, and those of that part of the surface of the cornea where the opacity existed; the inosculations all round the margin of the cornea were beautifully variegated, without trespassing that line which bounds the sclerotica, except on that side, where the cornea was affected with this species of opacity.

Mr. Travers does not adopt precisely the same definition of a nebula as Scarpa; for he describes it as a thickening of the conjunctiva, and an effusion of adhesive matter between it and the cornea, or *between the lamellæ of the latter*, commonly the product of acute strumous ophthalmy. (*Synopsis, &c.* p. 118.) Nebulous opacities are indeed universally admitted to be more numerous than what Scarpa represents.

According to Scarpa, the superficial opacity, which alone he calls nebula, demands, from its very origin, active treatment; for, though at first it may only occupy a small portion of the cornea, when left to itself it advances towards the centre of this membrane, and the ramifications of the dilated veins upon this coat, growing still larger, at length convert the delicate continuation of the conjunctiva upon the surface of the cornea, into a dense opaque membrane, obstructing vision.

The curative indication in this disease, as insisted upon by Scarpa, is to make the varicose vessels resume their natural diameters, or, if that be impracticable, to cut off all communication between the trunk of the most prominent varicose veins of the conjunctiva, and the ramifications coming from the surface of the cornea, the seat of the opacity. The first mode of treatment is executed by means of topical astringents, especially Janin's ointment, and *success attends it, when the opacity is in an early state, and not extensive. But when advanced to the centre of the cornea, the surest treatment appears to Scarpa to be the excision of the fasciculus of varicose veins near their ramifications, that is, near the seat of the opacity, with a pair of small forceps and curved scissors.* (*Scarpa sulle Melattie degli Occhi*, c. 8.)

According to the experience of Dr. Vetch, Scarpa's plan of removing the plexus of varicose vessels, together with a portion of the conjunctiva, produces no good effect, "except in cases of great relaxation of the membrane covering the eye." He asserts, that new vessels immediately appear in the room of those removed, and the good derived from the bleeding does not compensate for the irritation produced by the operation. (*A Practical Treatise on the Diseases of the Eye*, p. 86.) Another experienced writer also declares, that the plan of dividing the red vessels proceeding to the opaque part cannot be of any service. (See *Lawrence on Dis. of the Eye*, p. 372.) However, when it is reflected, that Scarpa advises this practice only for advanced cases, and particularly recommends topical astringents for the more recent stages of the disease, he nearly agrees with Dr. Vetch, as far as this point is concerned. But, Scarpa's account of the disease and its treatment is left imperfect by the omission of any notice of the connection, frequently existing, between opacity of the cornea, and a rough, scabrous, granulated state of the lining of the eyelids. Yet, perhaps, Scarpa was not to be expected to treat of this combination, in his chapter on nebula; because his definition of the superficial opacity will not altogether suit the affection of the same membrane, referred to in the following observations:—It is remarked by Dr. Vetch, that, after the complete cessation of conjunctival ophthalmia, as far as regards that portion of the membrane which covers the eye, the villous elongation of the vessels of the lining of the eyelids, instead of recovering their natural state, acquire a further increase of size, so as to produce a rough, scabrous, or granulated surface, with a secretion of puriform matter. The irritation of this unequal surface gradually induces an inflammatory state of the sclerotic vessels, and, consequently, a greater flow of blood towards the cornea: the superficial vessels become varicose; the conjunctiva assumes a dusky and loaded appearance; and the cornea becomes opaque, not partially, but throughout the whole extent of its structure. This affection, says Dr. Vetch, is essentially different from those nebulous, or partial opacities, which take place in primary sclerotic inflammation, and which consist in slight extravasations, accompanied by intolerance of light, and in which any affection of the palpebral linings is a secondary, instead of a primary circumstance. The cornea is of the green colour presented by a broken gun-flint; and while it is sufficiently diaphanous to permit the perception of light, it is yet too opaque to allow the patient to discern external objects, except by their shades. Nor can the colour of the iris, and limits of the pupil be seen. Dr. Vetch also describes the conjunctiva as being sometimes so much relaxed, and its vessels so generally loaded, as to give it a dusky appearance similar to that of the cornea; and, in other instances, without much alteration of its thickness, or transparency, it is said to lose for a considerable extent its close attachment to the subjacent lamina of the cornea. Along with the opaque state of the cornea, there is more generally an enlargement of individual vessels, which penetrate almost to its centre, increase as they come outwards, and terminate in trunks, which run to the duplicature of the conjunctiva. Dr. Vetch represents this disease of the palpebræ as consisting at first in a highly villous state of their membranous lining. This state, if not rectified by proper treatment, give birth to granulations, which, in time, become more deeply sulcated, hard, or warty, accompanied by an oozing of purulent matter. Dr. Vetch has explained, that the use of the actual cautery, excision, and friction, for the purpose of curing the diseased state of the eyelids, may be traced back to Hippocrates who prefers escharotics. Dr. Vetch ascribes their first employment in these cases to St. Ives. Mr. Saunders, he observes, took an early and just view of the relations, existing between the diseased conditions of the palpebral linings, and the opaque state of the cornea; and he succeeded in establishing the cure of the latter by the removal of the former. In short, Dr. Vetch admits, that, in the case, which more especially formed the claim of Mr. Saunders to the discovery of the nature of the disease, the practice of excision was attended with complete success. Dr. Vetch contends, however, that this method is, for the most part, inadequate to the cure of the disease; and that there are very few cases, in which the more certain and consistent process of gradually repressing the diseased surface by escharotic substances will not produce a more complete and permanent cure. After giving a fair trial to a great variety of escharotics, made into ointments, and applied to the inside of the upper eyelid, Dr. Vetch found the direct application of the escharotic substances themselves was preferable. When there is too much increased action in the vessels of the sclerotic coat, Dr. Vetch recommends the use of escharotics to be preceded by cupping on the temples; or, when there is any risk of a slough, the application of a leech to the inside of the lower eyelid. Whatever will bring on a determination of blood to the head is to be avoided, and a low regimen observed.

The escharotics, preferred by Dr. Vetch, are the sulphate of copper and nitrate of silver, scraped in the form of a pencil, and fixed in a portcrayon. In this way, he says, they should be applied, not, as some have conceived, with the view of producing a slough over the whole surface; but, with great delicacy, and in so many points only, as will produce a gradual change in the condition and disposition of the part. As long as there is any secretion of pus, the above application may be materially assisted by the daily use of the undiluted liquor plumbi acetatis. When the disease resists these remedies, and its surface is hard and warty, Dr. Vetch, applies to the everted surface, powder of verdigris, or burnt alum, finely levigated; or even lightly touches the diseased surface with caustic potash. In employing these remedies, he enjoins confining their operation to the point of contact, so as to prevent them from hurting the eye. Hence they are to be applied in very minute quantities with a fine camel's hair pencil, and to be washed off with an elastic gum syringe, before the eyelid is returned. Of the employment of astringent collyria, in conjunction with escharotics, Dr. Vetch disapproves. (See *Practical Treatise on the Dis. of the Eye*, p. 67, &c.) With respect to the treatment by excision, as first practised by Mr. Saunders with scissors, and afterwards by Sir W. Adams with a knife, the principle of cure does not appear to me different from that aimed at with escharotics, unless these latter be supposed not always to destroy, but sometimes to cause, an absorption of the fungous granulations. At present, the last method is considered most effectual; and, during the operation the eyelids should be everted over a probe.

For the form of disease, termed by Mr. Travers "strumous nebula, with vessels overshooting the cornea," this gentleman recommends ptyalism. He says, that, "the hydrargyrum cum creta, or oxy-muriate, in small, but frequent doses, will sometimes succeed better in this case, than the other forms of mercury, and the combination of calomel with antimony, better than that with opium." When the internal exhibition of mercury either disorders the bowels, or has no effect on the constitution, frictions are to be preferred. (*Synopsis* *of the Diseases of the Eye*, p. 282.) In the particular form of opacity, to which he alludes, he disapproves of dividing the vessels of the conjunctiva, before the inflammation has declined. (P. 285.)

The following varieties of corneal opacity are enumerated by Mr. Lawrence, as admitting of removal:—"A general dulness, or haziness, and sometimes a thin nebula of the cornea, occur in iritis, and other internal inflammations of the eye; the change appears diffused through its whole texture. Often a more or less thick film covers the cornea in the purulent ophthalmia of infants, the conjunctival layer being thickened and loosened by the inflammation; the cornea assumes a pale greyish colour, and this appearance sometimes extends over the whole surface. A general nebulous, or more opaque state of the cornea, is produced in corneitis. There is also nebulous opacity, often accompanied with some redness in strumous ophthalmia. These four cases present examples of impaired transparency, which admit of complete relief. Indeed, it is sufficient in these cases to arrest the inflammation, which has caused the opaque change, and the latter will disappear of itself. In the first, and the two last instances, there is general disturbance of the corneal circulation, and interstitial deposition; in the second, the mucous layer alone is the seat of change. The dotted opacity, caused by inflammation of the membrane of the aqueous humour also disappears, when the inflammation has been arrested.

"Another, and a denser kind of opacity arises from inflammation of a more serious character. The change affects the surface, and the corneal laminæ more or less deeply: it is interstitial deposition under considerable inflammation of the corneal texture." White and dense opacities of this kind may be lessened, but cannot be entirely removed. They may be occasioned by lime, or by effusion of matter when suppuration has taken place. In the latter case, the opacity has at first a yellowish, and subsequently a light brownish tint. When the corneal laminæ are affected throughout, it seems to Mr. Lawrence, that we cannot do much good. Our first object, where inflammation is present, is to stop it, and then the newly deposited matter will often be absorbed. In children this is exemplified with remarkable frequency. After having waited a little to see what the removal of inflammation will accomplish, Mr. Lawrence would try an issue, or seton in the temple, with regulation of diet and the stomach and bowels; and finally stimulants, and astringents, particularly a solution of the nitrate of silver, gr. ij. to each oz. of water, but gradually increased. This may either be dropped into the eye or applied to the opaque part by means of a camel-hair brush. (See *Lawrence on Dis. of the Eye*, p. 371.)

From some observations, published by Mr. Wardrop, it would appear, that certain opacities of the cornea are produced by an increase in the quantity of the contents of the eyeball, and not by the deposition of an albuminous fluid in the texture of the cornea, as takes place in the common speck. He considers this fact proved by cases, in which the cornea regained its transparency the instant the aqueous humour was evacuated. Some cases are detailed by this gentleman, with the view of recommending the practice of puncturing the cornea, and discharging the aqueous humour, for the relief of the kind of opacity to which I have here alluded. (See *Med. Chir. Trans.* vol. iv. p. 180, &c.)

For other opacities, refer to ALBUGO, LEUCOMA, and STAPHYLOMA.

ULCERS OF THE CORNEA.

An ulcer is a common consequence of the bursting of a small abscess, which not unfrequently forms beneath the delicate layer of the conjunctiva continued over the cornea, or in the very substance of the cornea itself, after violent ophthalmy. At other times, the ulcer is produced by the contact of corroding matter, or sharp-pointed bodies insinuated into the eyes, such as quick-lime, pieces of glass, or iron, thorns, &c. As Dr. Vetch has observed, ulceration of the cornea is a very frequent consequence of purulent ophthalmy. The little abscess of the cornea is attended with the same symptoms, as severe acute ophthalmy; especially with a troublesome sensation of tension in the eye, eyebrow, and nape of the neck, with ardent heat, copious secretion of tears, aversion to light, and intense redness of the conjunctiva, particularly near the point of suppuration. The inflammatory pustule, compared with similar ones in any other part of the body, is slow in bursting after matter is formed. Scarpa deems it improper, however, to puncture the small abscess; for, though it assumes the appearance of being perfectly maturated, the matter contained in it is so tenacious, and adherent to the substance of the cornea, that not a particle issues out of the artificial aperture, and the wound exasperates the disease, increases the opacity of the cornea, and often occasions another small abscess to form in the vicinity of the first. Indeed, if the observations of Mr. Travers be correct, "The ulcer of the cornea begins, not in abscess, but in a circumscribed deposit of lymph, or in purer ulcerative absorption without pus." (*Synopsis of the Dis. of the Eye*, p. 106.) And, Dr. Vetch takes notice, that the observation, with respect to fluid matter never forming in the cornea, he invariably found true in several cases, where the whole of the eyeball had been destroyed by inflammation. (*On the Dis. of the Eye*, p. 52.) This author differs from Scarpa, however, respecting the question of opening pustules or abscesses of the cornea; for, he remarks, that, whenever the matter or slough is removed, the ulcer, however deep and extensive, will fill up without leucoma being the consequence. By a little address, he says, it may, in most instances, be removed in a mass upon the point of a lancet, or couching-needle. (*Op.* cit. p. 50.) This remark applies both to cases, where lymph or tenacious matter more or less protrudes, and to instances, in which it is quite confined between the lamellæ of the cornea. Scarpa thinks that the safest plan is to temporize until the pustule spontaneously bursts, promoting it by means of frequent fomentations, bathing the eye with warm milk and water, and applying emollient poultices. The spontaneous bursting of the little abscess is usually denoted by a sudden increase of all the symptoms of ophthalmy; particularly by an intolerable burning pain at the point of the cornea, where the abscess first began, greatly increased by motion of the eye or eyelid. The event is confirmed by ocular inspection, and at the spot where the white pustule existed, a cavity appears, as may best be seen when the eye is viewed in the profile. Extraneous bodies in the eye, which have simply divided a part of the cornea, or lodged in it, when soon extracted, do not in general cause ulceration, as the injured part heals by the first intention. Those which destroy, or burn the surface of this membrane, or which, when lodged, are not soon extracted, excite acute ophthalmy, suppuration at the injured part, and at length ulceration.

As Dr. Vetch has observed, the appearance of ulceration varies according to the degree of apostemation, or tendency towards it, in the surrounding cornea: when this part is clear, the case is doing well; but when opacity comes on, the ulcer is increasing. The soft middle lamina, he says, is destroyed with great rapidity when the inflammation is violent; but as soon as the ulcer reaches the internal coat, it often proceeds no further. (*On Dis. of the Eye*, p. 52.)

The ulcer of the cornea, as Scarpa remarks, has this, in common with all solutions of continuity in the skin where this is delicate, tense, and endowed with exquisite sensibility, that, at its first appearance, it is of a pale ash-colour; has its edges high, and irregular; creates sharp pain; discharges, instead of pus, an acrid serum, and tends to spread widely and deeply. Such is the precise character of ulcers upon the cornea; and such is the nature of those upon the nipples of the mammæ, the glans penis, lips, apex of the tongue, the tarsi, the entrance of the meatus auditorius externus, nostrils, &c. Ulcers of this description, neglected or ill-treated, speedily enlarge, make their way deeply, and destroy the parts in which they are situated. If they spread superficially upon the cornea, the transparency of this membrane is destroyed; if they proceed deeply, and penetrate the anterior chamber of the aqueous humour, this fluid escapes, and a fistula of the cornea may ensue; and if they form a larger opening in it, besides the exit of the aqueous humour, they occasion another more grievous malady than the ulcer itself, namely, a prolapsus of a portion of the iris, an escape of the crystalline lens and vitreous humour, in short, a total destruction of the whole organ of sight. It is therefore of the highest importance, as soon as an ulcer appears upon the cornea, to impede its growing larger, as much as the nature of it will permit; the morbid process should be converted into a healing one, and the surgeon must exert his skill with more attention, the more extensively and deeply the ulceration has proceeded. According to Scarpa, the cicatrix of a larger ulcer impairs the texture of the cornea so much, that the injury is irreparable. Yet Dr. Vetch assures us, that when a slough covers an ulcer of considerable extent, and is taken off with great caution so as not to wound the inner tunic of the cornea, or, when it cannot be removed, if it be slightly scarified and divided, the cornea may recover its transparency after two-thirds of it have been in this state. (*On the Dis. of the Eye*, p. 51.)

They who inculcate that no external application can be adopted with benefit, for the cure of this disease, before the acute ophthalmy has been subdued, or at least diminished, are, in Scarpa's opinion, deceived. He argues that local remedies ought, in the very first instance, to be applied to the ulcer, such as are appropriate to lessen the irritability and stop the destructive process going on: and that afterwards means should be taken to cure the ophthalmy, if it does not subside gradually, as the ulcer heals. According to Scarpa's doctrine, it is the ulcer which keeps up the ophthalmy, not the ophthalmy the ulcer. The case, however, is excepted, in which the ulcer makes its appearance during severe ophthalmy. Here the first indication is to abate inflammation.

The view entertained by Mr. Lawrence, is precisely the opposite of that taken by Scarpa. Ulcers of the cornea, he observes, frequently occur in inflammation of the external tunics, in the purulent, and strumous ophthalmiæ. "Here, as in other instances, the ulcer is the consequence of inflammation; we should invert the order of occurrences, if we represented the latter, as produced by the irritation of the former. It is not necessary to adopt any local treatment merely in reference to the ulcer. The ordinary treatment must be employed for the inflammation. When that is removed, the ulcers will heal." (*Lawrence on Dis. of the Eye*, p. 368.)

Scarpa observes, that as soon as the sensibility in the ulcer abates, the ophthalmy retreats with equal speed; and when the ulcer heals, the inflammation disappears gradually, or, at most, requires only the use of an astringent and corroborant collyrium for a few days. He finds analogous examples of this in ulcers of other parts, particularly in the little foul ulcers on the inside of the lips, the apex of the tongue, the nipples, glans, penis, all which at their first appearance, assume an ash-coloured surface, and excite inflammation of the part in which they are seated. To subdue this inflammation, we do nothing more than cure the excessive irritability in these ulcers, and convert the ulcerative process into cicatrisation: this done, the surrounding inflammation immediately disappears of itself.

These good effects, Scarpa says, may be obtained by caustic, which will remove the irritability in the part affected; and convert the ash-coloured surface of the ulcer into an eschar, which, as a kind of epidermis will moderate the pressure of the neighbouring parts upon the ulcer, and at length convert the process of ulceration into that of granulation and cicatrisation.

The caustic to which Scarpa gives the preference, is the nitrate of silver scraped to a point like a pencil. The eyelids being opened, and the upper one raised by means of Pellier's elevator, the ulcer of the cornea is to be touched with the apex sufficiently to form an eschar. Should any of the caustic dissolve in the tears, the eye must be copiously bathed with warm milk, or a little oil of almonds be dropped into it. (*Ryall in Dubl. Trans.* vol. v.) At the instant the caustic is applied, the patient complains of a most acute pain; but this aggravation is amply compensated by the ease experienced a few minutes after the operation: the burning heat in the eye ceases; the eye and eyelids become capable of motion without pain; the flux of tears and the turgidity of the vessels of the conjunctiva decrease; the patient can bear a moderate light, and enjoys repose. These advantages last while the eschar adheres to the cornea.

On the separation of the eschar, sometimes at the end of two, three, or four days after the application of the caustic, the primary symptoms of the disease recur, especially the smarting and burning pain at the ulcerated part of the cornea; the effusion of tears; the restraint in moving the eye and eyelids; and the aversion to light; but all these inconveniences are less in degree than before. At their recurrence, the surgeon is to renew the application of the nitrate of silver, making a good eschar upon the whole surface of the ulcer, which will, as before, be followed by perfect ease in the eye. The application of the caustic is, if required to be repeated a third time; that is, if upon the separation of the eschar, the extreme irritability in the ulcer is not exhausted, and its progressive mischief checked. When the case goes on favourably, the sensibility of the eye is found lessened after each separation of the eschar; the ulcer also abandoning its pale ash-colour, assumes a delicate, fleshy tint; a certain sign that the destructive process, which prevailed, is turned into a healing one. The turgid state of the vessels of the conjunctiva, and the degree of ophthalmy, disappear in proportion as the ulcer draws near to a cure. As soon as ease is felt in the eye, and granulations begin to rise, whether after the first, second, or third application of the caustic the surgeon must refrain from its further employment, and use only the following collyrium: ℞ *Zinci Sulphatis gr.* iv. *Aq. Rosæ,* ʒ iv. *Mucil. sem. Cydon. mali* ʒss. M. This is to be used every two hours, the eye, in the intervals, being defended from the air and light, by means of a gentle compress, and retentive bandage. When, besides the ulcer of the cornea, a slight relaxation of the conjunctiva remains, Janin's ointment, towards the end of the treatment, introduced between the eye and eyelids, morning and evening, proves serviceable.

To cure those superficial excoriations of the cornea, which make no excavation in the substance of this membrane, and which, in reality, are only a detachment of the cuticle, covering the layer of the conjunctiva continued over the cornea, the use of caustic is not requisite. The above collyrium and the avoidance of too much light, and of exposure to the air will be sufficient.

According to Dr. Vetch, when the ulcerative process is likely to destroy the membrane, which lines the cornea, it can only be checked by measures calculated to subdue the inflammation, upon which it depends. "As long, therefore, as there is an appearance of activity in the disease, or recurrence of pain, local blood-letting, by cupping or leeches, must be steadily adhered to. The indication of the ulcer healing is easily seen in the diminished activity of the inflammation, relief from pain, and the clean aspect of the ulcerated part. The injection of vegetable, tepid, astringent infusions may be used, or milk and water only. When called upon in extreme cases, where the immediate perforation of the inner membrane is threatened, we may, with great propriety, resort to the operation of puncturing the cornea at a place as remote as possible from the ulcer. Next in importance to a diminution of the action, on which the ulcer depends, is the removal by scarification of any slough thrown out from its surface, or imbedded in the adjoining part of the cornea. Sometimes, but always subordinate to these indications, we may add some topical applications to the ulcer; a solution of nitrate of silver, the infusion of tobacco, or calomel in powder, applied with a camel's hair pencil." (*On Diseases of the Eye,* p. 57.) In incipient protrusions of the inner membrane of the cornea, this author decidedly condemns the use of the argentum nitratum in the free manner proposed by Scarpa; observing, that, "if the caustic touches by accident the edge of the ulcer, or any part but the apex of the projecting vesicle, it will often produce much mischief."

Sometimes the ulcer assumes the form of a fungous excrescence upon the cornea, appearing to derive its nourishment from a band of blood-vessels of the conjunctiva; and, on this account, it occasions, not unfrequently, a serious mistake in being taken for a real pterygium. Left to itself, or treated with slight astringents, it produces, in general, a loss of the whole eye. It requires the speedy adoption of some active and efficacious plan, to destroy all the fungus upon the cornea, to annihilate the vessels of the conjunctiva tending to it, and to impede the progress of ulceration. This consists first in cutting away the fungus, with a pair of small scissors, to a level with the cornea, continuing the incision far enough upon the conjunctiva, to remove, with the excrescence, that string of blood-vessels from which it seems to derive its supply. Having effected this, and allowed the blood to flow freely, Scarpa applies the nitrate of silver to all the cornea, which appears to have been the seat of the fungus, so as to make a complete eschar; and if, upon its separation, the whole morbid surface should not be destroyed, he repeats the caustic until the ulcerative process changes into a healing one.

The action of the caustic cannot always be calculated with precision, and therefore a portion of the whole thickness of the cornea may be destroyed with the fungus, which never fails to be followed by a prolapsus of part of the iris, through the aperture made in the cornea. This accident may seem grievous, yet it is not irreparable. (See Iris, Prolapsus of.)

Mr. Lawrence is not such an advocate as Scarpa for the employment of caustic, believing, that the notion of ulcers of the cornea commonly requiring its application has led to injurious practice. "Generally speaking (says he) I have found corneal ulcers to heal most rapidly under antiphlogistic treatment, and without the use of local stimuli, or astringents." And, "in obstinate cases of chronic ulceration, which, with little inflammation will sometimes creep slowly over the cornea, healing on one side, while it advances on the other (he adds) I have found great benefit from an issue in the temple." (*Lawrence, ibid.* p. 368.)

Dr. Mackenzie, in his practice, seems to take a middle course between that of Scarpa and that of Lawrence. "In all cases (says he) we endeavour of course, to check the ulcerative process by those measures, which are fitted for subduing the particular ophthalmia, in which the ulcer has taken its origin. The girl, whose case I have related, was in a state of great debility in consequence of over depletion. Within 24 hours, the tonic plan of treatment arrested the progress of a deep ulcer of one of her cornea. In chronic superficial ulcer, which often proves very tedious, calomel, given so as to affect the mouth, is sometimes necessary. In almost all cases of ulcerated cornea, counter irritation will be found useful. As the inflamed state of the eye abates, the patient finds the pain greatly relieved. It frequently happens, however, that the ulcer itself proves a principal cause of prolonging the inflammation." In such a case, Dr. Mackenzie recommends coating the ulcer with nitrate of silver in solution, or in substance, as an anodyne, superior to any sedative lotion, or internal narcotic. In cases of superficial ulcer, he considers it best to touch its surface with a hair pencil, dipped in a solution of from 4 to 10 grains of the nitrate of silver in an ounce of distilled water. Some prefer a solution of one grain of muriate of mercury in half an ounce of water, to which is added an equal quantity of vinum opii. Dr. Mackenzie, however, only sanctions the employment of nitrate of silver, when the ulcer betrays no disposition to heal of itself. (See *Mackenzie on Diseases of the Eye,* p. 577. ed. 2.) Every experienced surgeon will coincide with this gentleman, that, in all cases of deep and even in severe cases of superficial ulcers of the cornea near the centre of the pupil, the pupil should be kept dilated with belladonna. (*Ibid.* p. 580.) This is done to prevent the iris from getting in contact with the cornea, and becoming adherent to it. He recommends the belladonna, however, not to be dropped into the eye, but applied to the eyebrow and eyelids. In penetrating ulcer of the cornea, Mr. Middlemore is also in favour of belladonna. (*On Dis. of the Eye,* vol. i. p. 486.) Where the ulcer depends on severe inflammation, this gentleman aims at subduing the latter by means of bleeding and mercury. He admits, however, that mercury is hurtful in the deep crescentic ulcer of old feeble subjects, and in certain forms of sloughing and scrofulous ulceration of the cornea. In all cases of deep circumscribed ulcer, unattended by severe inflammation, he approves of touching the sore with the solid nitrate of silver. In slighter instances, and particularly in the extensive superficial ulcer, the lotion of zinc, or of the nitrate of silver, in the proportion of two or more grains to the ounce of water, seem to him preferable. (See *Middlemore on Dis. of the Eye,* vol. i. p. 483.)

Two cases of ulcer of the cornea are recorded, which were benefited by Mr. Wardrop's operation of puncturing the cornea and discharging the aqueous humour. In the first example, there was an ulcer on the central part of the cornea, and a cluster of blood-vessels passing towards it. The whole eyeball was also much inflamed. The puncture was made at the place where the vessels passed. The patient's severe headach was relieved, and under the use of fomentations, and the vinous tincture of opium, all the other symptoms rapidly subsided. In the second case, there were two or three erosions, with a good deal of muddiness of the cornea, headach, &c. The obscurity of this membrane instantly disappeared, and the headach subsided upon the aqueous humour being discharged. With the help of bleeding and fomentations, the symptoms abated, the ulcer healed in a few days, and the eye recovered. (See *Med. Chir. Trans.* vol. iv. pp. 186, 187.)

In superficial ulcers of the cornea, attended with much inflammation of the conjunctiva, Mr. Travers recommends opium, combined so as to operate upon the skin, and keeping the bowels well open. Here he differs from Scarpa, in specifying the use of the nitrate of silver, as the best local treatment. Warm fomentations, he says, afford temporary relief, and when the inflammation of the sclerotica is intense, he advises the exhibition of mercury. (*Synopsis of the Diseases of the Eye,* p. 278.)

With regard to the treatment of indolent, and deep-sloughing ulcers of the cornea, Mr. Travers praises, in addition to the employment of the nitrate of silver, the occasional use of leeches, and the administration of tonics and sedatives.

The same author has also noticed chronic interstitial ulcers, where the cornea is transparent, "but indented, like a bonce, when struck upon a marble hearth, or pitted, according as the ulcers are diffused, or circumscribed." These are said to succeed acute inflammation, when large quantities of blood have been lost, and to occur frequently in children imperfectly nourished, or in adults, who are very debilitated. With the aid of good diet, tonics, and moderate topical stimulants, like the vinum opii, or the zinc collyrium, they become hazy, which denotes the commencement of the adhesive inflammation. (*Op.* cit. p. 117.)

Saturnine lotions and ointments, applied to ulcers of the cornea, either superficial, or deep, produce an opaque cicatrix. Hence, they are totally inadmissible. (See *Jacob, in Dublin Hospital Reports,* vol. v. p. 369. *Mackenzie on Dis. of the Eye,* p. 576. ed. 2.)

Ossification of the Cornea.

Mr. Wardrop has seen only one instance of ossification of the cornea; and, in that case, the whole eye was changed in its form, and the cornea had become opaque. On macerating the latter part, a piece of bone, weighing two grains, oval-shaped, hard, and with a smooth surface, was found between its lamellæ. A piece of bone was also found between the choroid coat and retina.

The same gentleman informs us, that Walter had, in his museum, a piece of cornea, taken from a man sixty years of age, containing a bony mass, which was three lines long, two broad, and weighed two grains.

In Mr. Wardrop's publication, there is also recorded a curious case, in which a portion of bone was formed, either in the substance of the cornea, or immediately behind it, and which was extracted from the eye by Mr. Anderson, surgeon at Inverary. The patient was a woman thirty-one years of age, and the formation of the bony substance, which was about half as large as a sixpence, is said to have been occasioned by a fall against the root of a tree, fifteen years before the operation, by which accident the eye was struck, though not cut. (See *Wardrop's Essays on the Morbid Anatomy of the Human Eye,* vol. i. chap. 10.)

Alteration in the Form of the Cornea.

This is the last subject which I shall take notice of in the present article. It is well known, that the convexity of the cornea varies in different persons, and in the same individual at different periods of life, this part of the eye being naturally most convex in young subjects. It appears also from the experiments of the late Mr. Ramsden, and those of Sir E. Home, that the sphericity of the cornea is altered according to the distance at which objects are viewed.

Sometimes the cornea projects, or collapses, so considerably, without its transparency being affected, that sight is much impaired, or quite destroyed. The first case has been called, by some authors, the *Staphyloma pellucidum;* the second, *Rhytidosis.*

Leveillé, the French translator of Scarpa's book on the diseases of the eye, has described a case, in which the cornea of both eyes became of a conical form. Mr. Wardrop met with two examples of a similar disease; but only one eye was affected in each of them. In both cases, the conical figure of the cornea was very remarkable, and the apex in the cone was in the centre of the cornea. When the eye was viewed laterally, the apex resembled a piece of solid crystal; and when looked at directly opposite, it had a transparent sparkling appearance, which prevented the pupil and iris from being distinctly seen.

One of these cases occurred in a lady upwards of thirty years of age, and the changes produced in her vision were very remarkable. At the distance of an inch, or an inch and a half, she could plainly distinguish small objects, when held towards the temporal angle of the eye, although it required considerable exertion; but the sphere of vision was very limited.

On looking through a small hole in a card, she could distinguish objects held very near the eye, and could even read a book.

At any distance greater than two inches, vision was very indistinct; and at a few feet, she could neither judge of the distance, nor the form of the object.

When she looked at a distant luminous body, such as a candle, it was multiplied five or six times, and all the images were more or less indistinct. She could never find any glass sufficiently concave to assist her vision. She did not remark this complaint in her eye until she was about sixteen years of age, and it had undergone no change since that time.

In Mr. Wardrop's publication may be read a letter from Dr. Brewster, giving an explanation of the phenomena of the foregoing case.

It appears, that Mr. Phipps had opportunities of watching the progress of several cases, in which the cornea had become conical, and that he never saw the disease in persons under the age of fourteen or sixteen. The same gentleman also observed, that when the cone is once complete, the disease seldom makes any further progress, except that the apex sometimes becomes opaque.

Burgman saw a remarkable case, where the cornea of both the eyes of a person, who had been hanged, were so prodigiously extended, that they reached down to the mouth, like two horns. (*Haller, Disputationes Chirurg.* tom. ii.) The chapter of Mr. Wardrop on the preceding subject will be found highly interesting to such as are desirous of further information concerning this curious disease of the eye.

See *Wardrop*'s Essays on the Morbid Anatomy of the Eye, vol. i. chap. 13. For information relative to diseases of the cornea, see *M. Geiger*, De Fistula Corneæ, Tub. 1742. *C. F. Gifftheil*, De Ulceribus Corneæ, Tub. 1744. *J. W. Baury*, De Maculis Corneæ, &c. Tub. 1743. *G. H. Volger*, De Maculis Corneæ, 4to. Gött. 1778, *A. G. Richter*, Anfangsgr. der Wundarzn. b. iii. kap. 4. 8vo. Gött. 1795. Ant. Scarpa, Trattato delle Malattie degli Occhi, ed. 2. 8vo. Pavia, 1816, chap. 8. 10. *J. Beer*, Praktische Beobacht. über den grauen Staar, und die Krankheiten der Hornhaut, Wein. 1799, und Lehre von den Augenkr. b. 2. Wein, 1817. *M. J. Chelius*, Ueber die durchsichtige Hornhaut des Auges, ihre Function, und ihre Krankhaften Veränderungen, 8vo. Karlsruhe, 1818. *A. Clemens*, Diss. sistens Tunicæ Corneæ et Humoris Aquei Monographiam Physiologico-pathologicam, 4to. Gött. 1816. *J. Wardrop*, on the Morbid Anatomy of the Human Eye, vol. i. 8vo. edit. 1808. *B. Travers*, Synopsis of the Dis. of the Eye, 8vo. Lond. 1820. *J. Vetch*, on Diseases of the Eye, 8vo. Lond. 1820. *Isaac Ryall*, on the Use of nitrate of silver in certain affections of the Eye; Trans. of King's and Queen's Coll. of Physicians in Ireland, vol, v. art. 1. Dubl. 1828. *Dr. Jacob*, in Dubl. Hospital Reports; vol. 5. *W. Lawrence*, on Dis. of the Eye, 8vo. Lond. 1833. *William Mackenzie*, on Dis. of the Eye, ed. 2. 8vo. 1835. *Richard Middlemore*, on Dis. of the Eye, vol. i. 8vo. Lond. 1835.

CORNS. *Clavi. Spinæ pedum. Calli. Condylomata, &c.* A corn, technically called *clavus*, from its fancied resemblance to the head of a nail, is a brawn-like hardness of the skin, with a kind of root sometimes extending deeply into the subjacent cellular tissue. When this is the case, the indurated part is fixed; but while the hardness is more superficial, it is moveable. Some corns rise above the level of the skin, in the manner of a flat wart. They are hard, dry, and insensible, just like the thickened cuticle which is formed on the soles of the feet, or on the hands of labouring people.

In the first instance, a corn is a thickening of the cuticle, which is secreted by the cutis in a redundant horny form, from the influence of pressure. But, every thickening of the cuticle is not a corn, which term seems to Sir Benjamin Brodie, only applicable where the cuticle is thickened over a projecting portion of bone, on which the pressure is concentrated. A complete corn, he observes, is combined with the formation of a small bursa between the cuticle and the cutis. The thickened cuticle of corns, situated externally, becomes dry, hard, and horny; while that of corns, placed between the toes, remains soft, and in some degree moist: and hence the distinction into *hard* and *soft* corns. (See *Brodie* in *Lond. Med. Gaz.* for 1835, 1836. p. 776.)

Corns are entirely owing to repeated and long-continued pressure. Hence, they are most frequent in situations exposed to pressure, and where the skin is near bones, as on the toes, soles of the feet, &c. However, corns have occasionally been seen over the crista of the ilium, from the pressure of stays, and even on the ears, from the pressure of heavy ear-rings.

Corns of the feet are usually owing to tight shoes, and, consequently, are more common in the higher classes, and in women than other subjects. In females, indeed, the old ridiculous fashion of wearing high-heeled shoes was very conducive to corns. In shoes thus made, the whole weight of the body falls principally on the toes, which become wedged and compressed.

Though some persons who have corns suffer little, others occasionally endure such torture from them, that they are quite incapable of standing or walking. Doubtless the great pain proceeds from the irritation of the hard corn on the tender cutis beneath, which is frequently very much inflamed, in consequence of the pressure. Every thing which accelerates the motion of the blood, which heats the feet, which increases the pressure of the corn on the subjacent parts, or the determination of blood to the feet, or which promotes its accumulation in them, exasperates the pain. Hence, the bad effects of warm stockings, tight shoes, exercise, long standing, drinking, &c. The pain in warm weather is always more annoying than in winter.

If a person merely seeks temporary relief, it may be obtained by pulling off his tight shoes, sitting down, placing his feet in a horizontal posture, and becoming a little cool; the prominent portion of the corn should be cut off, as far as it can be done, without exciting pain, or bleeding, and the feet should be bathed in warm water.

When the bursa, under the horny cuticle, in consequence of inflammation, becomes distended with fluid, or suppurates, the pain and soreness are excessive, and the slightest pressure cannot be endured. Here the removal of the hard cuticle and letting out the confined fluid, small as it may be in quantity, give prompt relief. (See *Brodie*, in *Lond. Med. Gaz.* for 1835, 1836. p. 999.)

The radical cure essentially requires the avoidance of all the above causes, and, particularly, of much walking, or standing. Wide, soft shoes, should be worn. Such means are not only requisite for a radical cure, but they alone very often effect it. How many women become spontaneously free from corns in childbed, and other confinements! Though the radical cure is so easy, few obtain it, because their perseverance ceases as soon as they experience the wished-for relief.

When business, or other circumstances, prevent the patient from adopting this plan, and oblige him to walk or stand a good deal, still it is possible to remove all pressure from the corn. For this purpose, from eight to twelve pieces of linen, smeared with an emollient ointment, and having an aperture cut in the middle, exactly adapted to the size of the corn, are to be laid over each other, and so applied to the foot, that the corn is to lie in the opening, in such a manner that it cannot be touched by the shoe, or stocking. When the plaster has been applied some weeks, the corn commonly disappears, without any other means. Should the corn be in the sole of the foot, it is only necessary to put in the shoe a felt-sole, wherein a hole has been cut, corresponding to the situation, size, and figure of the induration.

A corn may also be permanently eradicated, by the following method, especially when the plaster, and felt-sole with a hole in it, are employed at the same time:—The corn is to be rubbed twice a day with an emollient ointment, such as that of marshmallows, or with the liniment of ammonia, which is still better; and in the interim, is to be covered with a softening plaster. Every morning and evening, the foot is to be put for half an hour in warm water; and whilst there, the corn is to be well rubbed with soap. Afterwards, all the soft, white, pulpy outside of the corn, is to be scraped off with a blunt knife; but, the scraping is to be left off, the moment the patient begins to complain of pain from it. The same treatment is to be persisted in, without interruption, until the corn is totally extirpated, which is generally effected in eight or twelve days. If left off sooner, the corn grows again.

A multitude of other remedies for curing corns are recommended. They all possess, more or less, an emollient and discutient property. The principal are green-wax, soap, mercurial and hemlock plasters, a piece of green oil-skin, &c. They are to be applied to the corn, and renewed as often as necessary. A successful composition consists of two ounces of gum ammoniacum, the same quantity of yellow wax, and six drachms of superacetate of copper. In a fortnight, if the corn yet remain, a fresh plaster is to be applied.

It is frequently difficult and hazardous to cut out a corn. The whole must be completely taken away, or else it grows again; and the more frequently it is partially cut away, the quicker is its growth rendered. When the skin is moveable, and, consequently, the corn not adherent to the subjacent parts, its excision may be performed with facility and safety, but not without pain. But, in the opposite case, either leaving a piece of the corn behind, or wounding the parts beneath, can seldom be avoided.

Mr. Wardrop recommends cutting, or tearing away, as much of the corn as can be done with safety; then keeping the toe for some time in warm water; and after the adjacent skin has been well dried, rubbing the exposed surface of the corn with the argentum nitratum, or wetting it, by the means of a camel's-hair pencil, with a solution of the oxymuriate of mercury in spirit of wine. Either of these applications, two or three times repeated, he says, will mostly effect a cure. (See *Med. Chir. Trans.* vol. v. p. 140.)

Mr. Higginbottom recommends the employment of nitrate of silver nearly in the same manner as Mr. Wardrop. The corn is to be softened by keeping the foot in warm water for half an hour. As much of the corn is then to be removed, with a sharp knife, as can be done without making a wound. The corn and surrounding skin are then to be moistened with warm water, and the nitrate of silver rubbed on the corn very freely and lightly on the skin, so as not to occasion vesication. The part is then to be exposed in order that it may become dry. About the fourteenth day, when the cuticle around the corn is peeling off, the foot is to be put in warm water again, and the silver, and as much of the subjacent corn as possible removed with a knife. Then the nitrate of silver is to be reapplied, and the plan repeated, till the corn is perfectly destroyed. (See *Higginbottom on the use of Nitrate of Silver*, p. 177, ed. 2. Also *Callisen's Syst. Chir. Hodiernæ*, part. ii. p. 200.)

COUCHING. The depression of a cataract out of the axis of sight, or the displacement, breaking, and disturbance of the opaque lens in various ways with a kind of needle for these purposes, so as to bring about the dispersion and absorption of it. (See Cataract.)

COUVRE CHEF. The name of a bandage. (See Bandage.)

CRANIUM, FRACTURES OF. (See Head, Injuries of.)

COXALGIA. See Joints, Diseases of.

CREOSOTE. (See Kreosote.)

CREPITUS. The grating sensation, or noise, occasioned by the ends of a fracture, when they are moved, and rubbed against each other; one of the most positive symptoms of the existence of such an accident.

CUPRI SULPHAS (*Sulphate of Copper*) is an escharotic, and an ingredient in several lotions for ulcers, collyria for the eyes, and injections for the urethra.

CURVATURE OF THE SPINE. (See Vertebræ, Diseases of.)

CYSTITOME. (from κύστις, and τέμνω, to cut.) An instrument, invented by M. de la Faye, for opening the capsule of the crystalline lens.

CYSTOCELE. (from κύστις, the bladder, and κήλη, a tumor.) A hernia, formed by a protrusion of the bladder. (See Hernia.)

CYSTOTOMIA. (from κύστις, the bladder, and τέμνω to cut.) The operation of opening the bladder, for the extraction of a stone or calculus. (See Lithotomy.)

CUPPING is performed by means of a scarificator, and a glass, shaped somewhat like a bell. The scarificator is an instrument containing a number of lancets, sometimes as many as twenty, which are so contrived, that when the instrument is applied to any part of the surface of the body, and a spring is pressed, they suddenly start out, and make the necessary punctures. The depth to which the lancets penetrate, may be made greater or less, at the option of the practitioner. As only small vessels can be thus opened, a very inconsiderable quantity of blood would be discharged, were not some method taken to promote the evacuation. This is commonly done with a cupping-glass, the air within the cavity of which is rarified by the flame of a small lamp, containing spirit of wine, and furnished with a thick wick. This plan is preferable to that of setting on fire a piece of tow, dipped in this fluid, and put in the cavity of the glass: "a clumsy expedient, adding unnecessarily to the sufferings of the patient, by cauterizing the skin; doing harm also by rarifying the air more than necessary within the glass, in consequence of which the edges of the cup compress the cutaneous vessels so much as to obstruct the influx of blood. The larger the glass, if properly exhausted, the less pain does the patient suffer, and the more freely does the blood flow." (See *Mapleson on the Art of Cupping*, p. 63—65. 12mo. Lond. 1813.) According to Dr. Osborne, those cupping-glasses, which have broad spreading edges are far inferior, both in convenience of application, and in power of preserving a vacuum to those with perpendicular edges. He also recommends an assortment of cupping-glasses with oval and other shaped mouths. (See *Dublin Journ. of Med. Science*, vol. iii. p. 341.) When the mouth of the glass is placed over the scarifications, and the rarified air in it becomes condensed as it cools, the glass is forced down on the skin, and a considerable suction takes place.

When the operation is about to be done, a basin of warm water, a piece of fine sponge, and a lighted candle, should be provided. As many of the cupping-glasses as may be judged necessary are to be put in the basin. If sixteen or twenty ounces of blood are to be taken away, four glasses of a size adapted to the surface to which they are to be applied, will generally be required. Each glass is then to be held for an *instant* over the flame of the spirit-lamp, and immediately placed upon the skin. Upon the quickness with which this is done, the neatness and efficacy of the operation will depend. If dry cupping be only intended, the glasses may be allowed to remain on the skin for a few moments, and be replaced five or six times, with a little variation of their position, in order to prevent the skin from being hurt by their pressure. If the intention be to scarify and take away blood, the glass ought not to remain more than a minute, when the scarificator is to be *instantly* applied; for by the quickness with which the application of the scarificator succeeds the removal of the glass, the patient is saved a degree of pain, which he would otherwise suffer from the making of the punctures. When the glasses are so full as to be in danger of falling off, or the blood is coagulated in them, they should be removed, emptied, and applied again. For the sake of neatness, care should be taken to insert the nail under the upper part of the glass, and remove it so as to keep its bottom downwards, the scarifications being at the same time wiped with a sponge, wet in warm water. The glasses also, previously to each application, should be rinsed in warm water, but not dried. For other useful directions, see *Mapleson's Treatise*, p, 64, &c.

Trials have been made of syringes, calculated to exhaust the air from cupping-glasses; but the plan is not found so convenient as that above described.

A common pledget, or bit of rag, is usually applied as a dressing for the punctures made with a scarificator.

If a little smarting be not minded, Mr. Mapleson prefers the application of arquebusade water, or spirits of wine, as it immediately stops the oozing of blood, and prevents subsequent itching. (P. 69.)

Instead of a scarificator, Dr. Osborne recommends an instrument, which he proposes to name *polytome*, which consists of several lancets with circular edges, fixed parallel in a frame, to which a convenient handle is attached. The instrument is drawn rapidly along the skin, so as to make a row of continuous incisions of about one-sixteenth or one-eighth of an inch in depth and an inch in length. This instrument has been suggested as better calculated, than a scarificator, to insure an adequate discharge of blood. (See *Osborne in Dublin Journ. of Med. Science*, vol. iii. p. 340.) Such an instrument might perhaps be added to the case of cupping instruments with advantage, if it were only to be employed where the short deep punctures of common scarificators failed to procure a sufficient degree of bleeding.

CURETTE. (French.) An instrument, shaped like a minute spoon, or scoop, invented by Daviel, and used for taking away any opaque matter, which may remain behind the pupil after a cataract has been extracted.

DACRYOMA. (from δακρύω, to weep.) An impervious state of one or both the puncta lachrymalia, preventing the tears from passing into the lachrymal sac.

DAUCUS. See Cataplasma Dauci.

DECOCTUM CHAMŒMELI. ℞. Florum chamœmeli, ℥ ss. Aquæ distillatæ, lbj. Boil ten minutes, and strain the liquor. A common decoction for fomentations. (See Fomentum.)

DECOCTUM DULCAMARÆ. ℞. Dulcamaræ caulis concisæ unciam, Aquæ octarium cum semisse. Decoque ad octarium, et cola.

The decoction of bittersweet, or woody nightshade, is occasionally given in the treatment of various cutaneous diseases. The dose is one or two table spoonfuls, three times a day. An aromatic tincture should be added.

DECOCTUM HELLEBORI ALBI.—(*Decoctum Veratri.*) ℞. Pulveris radicis hellebori albi, ℥ j. Aquæ distillatæ, lbij. Spiritus vinosi rectificati, ℥ ij. Boil the water and powder, till only one-half the fluid remains, and when cold, add the spirit.

This is used as a lotion for psora, porrigo, and some other cutaneous affections.

DECOCTUM LOBELIÆ. (*Blue Cardinal Flower of Virginia.*) ℞. Radicis lobeliæ syphiliticiæ siccæ manip. j. Aquæ distillatæ, lb. xij. Boil till only four quarts remain. The lobelia, once praised for its virtues in syphilis, is now scarcely ever thought of in the treatment of that disorder. The patient is at first to take half a pint twice, and afterwards four times a day. It operates, however, as a purgative, and the doses must be regulated according as the bowels bear them.

DECOCTUM MEZEREI. ℞. Corticis radicis mezerei recentis, ʒ ij. Radicis glycirrhizæ contusæ, ℥ j. Aquæ distillatæ, lbiij. Boil the mezereon in the water, till only two pints remain; and, when the boiling is nearly finished add the liquorice root. Formerly more prescribed than at present for venereal nodes and nocturnal pains in the bones, in doses of from four to eight ounces, three times a day.

DECOCTUM PAPAVERIS. ℞. Papaveris somniferi capsularum concisarum, ℥ iv. Aquæ, lbiv. Boil for a quarter of an hour, and strain. A common fomenting fluid.

DECOCTUM SARSÆ. ℞. Sarsæ radicis concisæ, ℥ iv. Aquæ ferventis, lbiv. The sarsaparilla is to be macerated for four hours, near the fire, in a vessel lightly closed. The root is then to be taken out, bruised and put into the fluid again. The maceration is to be continued two hours longer, after which the liquor is to be boiled till only two pints remain. Lastly, it is to be strained.

DECOCTUM SARSÆ COMPOSITUM. ℞. Decocti sarsæ ferventis, lbiv. Sassafras radicis concisæ, guaiaci ligni rasi glycirrhizæ radicis contusæ, singulorum, ℥j. Mezerei radicis corticis, ʒiij. To be boiled together for a quarter of an hour, and then strained. This, and the preceding decoction of sarsaparilla, are much prescribed in venereal cases, and, at the present time, are often prescribed in combination with hydriodate of potash, in doses of from three to five grains of the latter, three times a day. Sarsaparilla is also given for the cure of a variety of cutaneous diseases, and in scrofula.

The simple decoction is frequently directed for the restoration of the constitution after a course of mercury, sometimes mixed with an equal quantity of milk. The common dose of both the decoctions is from four to eight ounces, three times a day.

The compound one possesses similar qualities to those of the famous Lisbon diet drink, for which it is now a common substitute.

DECOCTUM ULMI. ℞. Ulmi corticis recentis contus. ℥iv. Aquæ, lbiv. Boil to two pints, and then strain the liquor. Frequently prescribed in cutaneous diseases.

DECOCTUM VERATRI. See Decoctum Hellebori Albi.

DELITESCENCE. When an external inflammation, with its usual effects, swelling, redness, &c. subside with extraordinary rapidity, the case is said to terminate in *delitescence*.

DEPRESSION OF THE SKULL. See Head, Injuries of.

DEPRESSION OF THE CATARACT. (See Cataract.)

DETERMINATION. When the blood flows into a part more rapidly and copiously than is natural, it is said, in the language of surgery, that there is a *determination* of blood to it.

DIÆRESIS. (from διαιρέω, to divide.) A division of substance; a solution of continuity. This was formerly a sort of generic term applied to every part of surgery, by which the continuity of parts was divided.

DIGESTION. (from *digèro*, to dissolve.) By the *digestion* of a wound, or ulcer, the old surgeons meant bringing it into a state, in which it formed healthy pus.

DIGESTIVES. Applications which promote this object.

DIORTHOSIS. (from διορθόω, to direct.) One of the ancient divisions of surgery: it signifies the restoration of parts to their proper situations.

DIPLO'PIA. (from διπλοῦς, double, and ὦψ, the eye, or ὄπτομαι, to see.) *Visus duplicatus.* Even when the eyes are perfectly healthy, an object, under certain circumstances, appears double when viewed with both of them. "Thus, (as Dr. Arnott has observed) if a person hold the two forefingers in a line from his eyes, so that one may be more distant than the other, by then looking at the nearest, the more distant will appear double, and by looking at the more distant, the nearer will appear double." (*Elem. of Physics*, vol. ii. p. 217.) It is not, however, double vision of this kind, which I mean here to consider; but only those forms of the disorder, which depend upon, or are connected with morbid or abnormal states either of the eye itself, or other parts, which directly or indirectly exercise an influence over it. Double vision is of two kinds. For instance, the patient either sees an object double, treble, &c. only when he is looking at it with both his eyes, and, no sooner is one eye shut, than the object is seen single and right; or else he sees every object double, whether he surveys it with one or both his eyes. The disorder is observed to affect persons in different degrees. Patients seldom see the two appearances which objects present, with equal distinctness; but generally discern one much more plainly and perfectly than the other. The first distinct shape, which strikes the eye, is commonly that of the real object, while the second is indistinct, false, and visionary. Therefore, patients labouring under this affection, seldom make a mistake, but almost always know which is the true and real object. However, there are cases in which the patient sees with equal clearness the two appearances which things assume, so that he is incapable of distinguishing the real object from what is false and only imaginary.

The disorder is sometimes transitory and of short duration, and may be brought on in a healthy eye by some accidental cause, generally an irritation affecting the organ. Sometimes, the complaint is continual; sometimes, periodical. In particular instances, the patient only sees objects double, when he has been straining his sight for a considerable time, as, for example, when he has been reading a small print for a long while by candlelight. In this case, the disorder becomes lessened by shutting the eyes for a few moments. There are also instances, in which the objects have a double appearanee only at a particular distance, and not either when they are nearer or further off. Sometimes the patient sees objects double only upon one side; as, for example, when he turns his eyes to the right hand, while nothing of this sort is experienced in looking in any other direction. In certain cases, objects appear double, in whatever way the eyes are turned and directed.

The causes of double vision may be divided into four classes. Namely, the object which the patient looks at, may be represented double upon the retina; which is the effect of the first class of causes. Or, the object may be depicted in one eye differently from what it is in the other, in regard to size, position, distance, clearness, &c.: this is the effect of the second class of causes. Or, the object may appear to one eye to be in a different place from that which it seems to the other to occupy; the effect of the third class of causes. Or, lastly, the sensibility of the optic nerves is defective, so that the image of an object, though it may appear single to one eye as well as the other, yet, in one identical situation will seem double to both of them. When the complaint originates from causes of the first and fourth class, the patient sees things double, whether he is using only one, or both eyes; but, when it proceeds from the second and third classes of causes, the patient sees objects double only when he is looking at them with both eyes, and no sooner does he shut one, than objects put on their natural, single appearance.

The following are the chief causes of the first class of a single object being depicted upon the retina as if double:—1. An unevenness of the cornea, which is divided into two or more convex surfaces. (*Haller, Element. Physiol.* t. v. p. 85.) According to Beer, this conformation of the cornea is mostly a result of several preceding ulcers of that membrane, in which circumstance the patient sees with the affected eye not merely double, but treble, and quadruple, of which facts Beer has met with some examples. (*Lehre von den Augenkr.* b. ii. p. 31.) However, in a far greater number of instances, such unevenness of the cornea, though equally considerable, does not occasion this defect of sight. We have principally an opportunity of observing cases of this sort after the operation of extracting the cataract. Hence it would seem, that the inequalities must be of very particular shape to produce double vision. The diagnosis of this cause is easy enough; but, the removal of it is impracticable; for, how is it possible to restore the original shape of the cornea? On this case, however, Beer delivers a more favourable prognosis than Richter; for he states, that, when the patient is not decrepit, the double vision, from altered shape of the cornea, will gradually disappear of itself, when proper care is taken of the constitution, and in particular of the eye. (B. ii. p. 32.) 2. An inequality of the anterior surface of the crystalline lens, whereby the same is divided into several distinct surfaces, it is suspected may be one cause of diplopia. M. Prévost has given the history of his own case of double vision with a single eye, which he conceives may arise from such a cause. (See *Annales de Chimie*, &c. t. 51. p. 210. Paris. 1832.) An instructive case of irregular refraction from some defect in the lens, is that of Professor Airy, who derived vast assistance from a lens, the spherical surface of which was 3⅓ inches, and the cylindrical 4½ inches. Vision was most distinct when the cylindrical surface was turned from the eye, and the glass close to the organ. (See *Trans. of Cambridge Phil. Soc.*) A double aperture in the iris, or, as the case is termed, a double pupil, and a deviation of the pupil from its natural position, have been enumerated as causes of diplopia. (*Baumer, in Act. Soc. Hassiac,* t. i. No. 27.) However, Richter deems the reality of the first of these causes doubtful; for cases have been noticed where double vision was not the effect of there being two openings in the iris. (*Janin, Mém. sur l'Œil.*) But, were the disorder actually to originate in this way, the experiment might be made of converting the two apertures into one.

The causes of the second class, by the effect of which the object is represented, in regard to its size, position, distance, &c. differently in one eye from what it is in the other, are for the most part rather possible, than such as have been actually observed. The causes which make objects assume an appearance contrary to the real one, may sometimes be confined to one eye, to which things are depicted diversely from what they are to the other healthy eye, so that the patient sees, as it were, double. Thus, for example, there may be a stronger refraction of the rays of light in one eye, than the other; the patient may be a *myops* with one eye, and a *presbyops* with the other; and then the object will seem to one eye large, to the other small; to one eye distant, to the other plainly near. This state of the sight, indeed, is said to have occurred after operating upon a cataract in one eye. (*Heuermann.*) However, that this is not always the consequence of operating upon a cataract in one eye, while the other is perfect, is sufficiently clear. (See CATARACT.) In particular examples, perpendicular objects seem to have a sloping posture. When it is considered, that only one eye is thus affected, and that to it things will appear sloping, and to the other straight, double vision must be the effect. (See SIGHT, DEFECTS OF.)

When both eyes are so directed to an object, that it becomes situated in the axis of vision of each of these organs, such object is represented in both at the same place, that is, it is depicted upon that part of the retina, on which the axis of sight falls. Thus, the object seems to both eyes to be in the same place, and though the two organs discern the thing, it only communicates a single appearance. But, when one eye is turned to any object in a different direction from that of the other; that is to say, when one eye is turned to an object in such a way, that the object is situated in the axis of vision of this eye, while the opposite eye is so turned, that the same object is placed on one side of its axis of vision; in other words, when a person squints; the object is depicted in one eye upon a different part of the retina from what it is in the other; consequently, the object appears to the two respective organs to be differently situated, and the patient is affected with diplopia. This is the third species of this disorder, which arises from strabismus as a third kind of occasional cause. Such patients naturally see objects double only when they behold them with both eyes. A lady, whom I know, is much annoyed with diplopia, the effect of deep-seated disease in the orbit, whereby the eye is forced out of its natural position.

A person who squints, usually has one eye stronger than the other, and the weakness of one of those organs is the common cause of the strabismus. Such a person does not see objects double, because he only sees with one eye well, and with the other so faintly and imperfectly, that scarcely any impression is made. Hence, every case of strabismus is not necessarily combined with diplopia; indeed, the common kind of squinting is not joined with it. A person affected with strabismus, only sees double when the sight of each eye is equally strong, and when the squinting does not depend upon any weakness of one of the eyes, but, upon some other occasional causes. The principal causes of the latter sort are of a spasmodic nature, viz.: an irritation affects some muscle of the eye in such a manner, that the patient is incapacitated from moving both his eyes according to his will, and from directing them to any object, so that such object may be at once in the axis of vision of both.

On this case, the observations of Sir E. Home are interesting, who has made various reflections on the effect of an irregular action of the straight muscles of the eye in producing double vision. (*Phil. Trans.* 1797.) Perhaps, however, the cases adduced furnish no very conclusive evidence that the diplopia depended merely on the state of the muscles, independent of that of the brain. (See *Mackensie on Dis. of the Eye*, p. 30. ed. 2.)

Richter states, that, in the majority of cases, the irritation is seated in the gastric organs, though any other species of irritation may operate upon the eyes in a similar manner. This kind of diplopia is frequently attendant on other spasmodic diseases as a symptom. It often accompanies hypochondriasis. Sometimes, it is the consequence of violent pain. Richter informs us of a man who saw double, and squinted, during a severe headach. He states, that another was affected in the same way during a toothach. Sometimes diplopia is owing to a paralysis of one of the muscles of the eye (*Morgagni de Sedibus et Causis Morborum*, epist. xiii. art. 20. *a paralysis of the abductor muscle*); sometimes to a tumour in the orbit. The diagnosis of this kind of diplopia is free from difficulty; the patient having been affected with squinting, ever since things appeared double to him.

The views which Sir E. Home took of diplopia from irregular action, spasm, or weakness of any particular muscle of the eye, led him to propose a plan of treatment, the principle of which is to keep the muscle affected for a time perfectly at rest, which is easily done by covering the eye with a bandage, and not allowing the organ to be at all employed.

The fourth class of causes are such irritations as act upon the optic nerves, changing their sensibility in such a way, that objects do not make that sort of impression upon them which they ought to do. Thus, things sometimes have the appearance of being coloured, when they are really not so; immoveable objects seem in motion, straight objects appear oblique, and in the cases which we are now treating of, single things seem to the eye double, treble, &c. This faulty kind of sensibility may also be produced by irritation in eyes which are perfectly sound; but, it is most readily occasioned in eyes which are preternaturally weak and irritable. In these, very trivial irritations will often excite it. In the treatment, the common indication is to discover and remove whatever irritation conduces to this effect; but the attempt frequently fails. In irritable eyes, the disorder is often brought on by very slight irritations, which cannot always be diminished, or removed. Here, the grand indication is to cure the weakness and irritability of the organs.

According to Richter, the fourth class of causes of diplopia is the most frequent. The irritations are of various kinds, and generally seated in the abdominal viscera. Diplopia is sometimes the consequence of inebriety, foulness of the stomach, intermitting fevers, hypochondriasis, worms, &c. However, the complaint is occasionally excited by other sorts of irritation. It has frequently followed a violent fright. It may be connected with spasmodic and painful diseases of several kinds. Severe headachs and toothachs are sometimes joined with this affection of the sight. Richter mentions a boy, who, being in the woods, was struck by the bough of a tree over the eye; and, in consequence of the accident, became affected with diplopia. He informs us of a man who rode a journey on horseback along a snowy road on a very sunshiny day, and was affected in the same manner. This affection of the eyes is sometimes the effect of injuries of the head. (See *Hill's Cases in Surgery*, p. 108. *Schmucker, Med. Chir. Remerk*, b. i. No. 26. *Hennen's Military Surgery*, p. 345. ed. 2.) In the North London Hospital there is at the present time (January, 1837), a woman, under my care, who was admitted on account of a blow on her head, whereby she was stunned. On recovering from this, she became affected with diplopia. At first, all objects appeared double, unless one eye were shut: afterwards, they were seen correctly with both eyes open, if within six or eight inches of these organs. In a still later stage, objects above the horizontal line were seen single; below it, double, except when one eye was shut

Persons who have weak eyes are apt to become double-sighted, whenever they look attentively for a long while at any light shining objects. Patients in fevers are also sometimes double-sighted. (*Gooch's Cases*, &c. vol. ii.)

Diplopia frequently terminates in some other disorder of the eyes, and is often the forerunner of amaurosis.

The cure partly depends upon the nature of the remote cause, and partly upon the condition of the eye. Some causes are easy; others difficult, of removal.

The treatment consists in endeavouring to find out and remove the irritation occasioning the disorder. The majority of such irritations are of the same nature as those which give rise to gutta serena. (See Amaurosis.) Indeed, both the complaints are often only different effects of the same cause, and of course require a similar mode of treatment. The boy, whom Richter mentions as having become double-sighted, in consequence of being struck over the eye with the bough of a tree, was cured by the external use of the infusum radicis valerianæ and spiritus vini crocatus, with which the eyelids and adjacent parts were rubbed several times a day. A diplopia, which followed a violent fright, was cured by valerian, preceded a few doses of bitartrate of potash. The case recorded by Dr. Hennen, as proceeding from a gunshot wound of the soft parts, covering the root of the nose and right eyebrow, yielded to abstinence, occasional emetics, and cold collyria. (*Principles of Mil. Surgery*, ed. 2. p. 345.) The woman in the North London Hospital, who had diplopia as a consequence of concussion of the brain, was materially benefited by cupping, and purgative medicines, followed up by mercury, and blistering the nape of the neck; and latterly, by the exhibition of the carbonate of iron. A hypochondriacal patient got rid of the disorder by means of the warm bath. A diplopia, supposed to arise from disorder of the biliary secretion, was cured by means of pills made of gum galbanum, guaiacum, rhubarb, and Venice soap, assisted with emetics and purgatives.

When the irritation is only of temporary duration, as, for instance, that of looking at shining objects; when the disorder continues after the removal of the irritation; or, lastly, when the irritation cannot be well detected; the surgeon is to endeavour, by means of nervous and soothing medicines, either to remove the impression, which the irritation has left upon the nerves, or to render the nerves insensible to the continuing irritation. The following remedies have proved useful in cases of diplopia: — Hartshorn, dropped into the hand, and held before the eyes; the external use of the spiritus vini crocatus; warm bathing of the eye, particularly, in a decoction of white poppy heads; bathing the eye in cold collyria; the internal administration of bark, valerian, small doses of ipecacuanha, oxide of zinc, and oleum cajeput. (See *Richter's Anfangsgr. der Wundarzn.* b. iii. kap. 15.)

According to Beer, the diplopia, which is not an effect of the continuance of another disease after inflammation of the eye; but probably depends upon injury of the retina, caused by such inflammation, usually diminishes, without the assistance of art, if the eye be not abused. (*Lehre von den Augenkr.* b. ii. p. 32.)

See *A. Vater* et *J. C. Heinicker*, Visus Vitia duo rarissima; alterum duplicati, alterum dimidiati, &c. Witemb. 1723. (*Haller* Diss ad Morb. t. i. p. 305.) *J. J. Klaukold*, De Visu duplicato, 4to. Argent, 1746. *Buchner*, De Visione simplici et duplice, 4to. Argent, 1753. Euler, Récherches Physiques sur la diverse Réfrangibilité des rayons de lumière; Mém. de l'Acad. des Sciences, &c. Berlin, p. 200. 1754. *Klinke* De Diplopia, 4to. Gött. 1774, *B. Gooch*, Chir. Cases, &c. vol. ii. p. 42. &c. 8vo. Lond. 1792. *Sir E. Home*'s Obs. on the Straight Muscles of the Eye, and the Structure of the Cornea, in Phil. Trans. for 1797. *Keghellini*, Lettera sopra l'offera della cista in una Donna, &c. 8vo. Venet, 1749; An instance of Diplopia from double pupil. Dict. des Sciences Méd. t. ix. p. 497. *J. Wardrop*, Essays on the Morbid Anatomy of the Human Eye vol. ii. p. 216, &c. 8vo. Lond. 1818. *Robert G. Graves*, M.D., on Double and Single Vision, in Dubl. Journ. of Med. Sciences. vol, i. p. 255. 8vo. 1832. *Mackenzie*, on Dis. of the Eye, ed. 2. Airy, in Trans. of Cambridge Phil. Society.

DIRECTOR, an instrument, in such common requisition, that it is always contained in every pocket case. It ought to be made of silver, which qualifies it to be bent into any convenient shape. Its ordinary use is to direct the knife, and protect the parts underneath from its edge or point. The surgeon introduces the director under the parts which he means to divide, and then either cuts down, along the groove, with a common bistoury, or cuts upward with a narrow, curved-pointed bistoury, the point of which is turned upwards, and which he carefully introduces along the groove. This instrument and the probe-pointed bistoury are commonly employed for opening sinuses, for cutting fistulæ in ano, and fistulæ in other situations, and for dilating the stricture in hernia. The French employ the director very commonly in that stage of operations for aneurism, in which the artery is to be separated from the adjacent vein, or nerve: the director is put under the artery, which the surgeon then examines carefully, and even presses upon, to ascertain what effect is produced on the pulsations of the aneurism, and whether any of the consequences of pressing on a nerve are excited. If the experiment be satisfactory, the ligature is then introduced with an eye probe, which is passed along the groove of the director. This plan was pursued by Dupuytren. (See *Clin. de Chir.* t. i. p. 277.)

DISLOCATION. (from *disloco*, to put out of place.) *A Luxation.* When the articular surfaces of the bones are forced out of their proper situation, the accident is termed a *dislocation* or *luxation.*

Sir Astley Cooper has justly remarked, that, of the various accidents, which happen to the body, there are few, which require more prompt assistance, or in which the reputation of the surgeon is more at stake, than cases of luxation; for, if much time be lost prior to the attempt at reduction, there is great additional difficulty in accomplishing it, and it is often entirely incapable of being effected. If it remains unknown, and consequently unreduced, the patient becomes a living memorial of the surgeon's ignorance, or inattention. Hence, this experienced surgeon forcibly inculcates the careful study of anatomy; the want of an accurate knowledge of the structure of the joints being the chief cause of the many errors, which happen in the diagnosis and treatment of dislocated bones. The following passage cannot be too deeply impressed upon the surgeon's mind: — "A considerable share of anatomical knowledge is required to detect the nature of these accidents, as well as to suggest the best means of reduction; and, it is much to be lamented, that students neglect to inform themselves sufficiently of the structure of the joints. They often dissect the muscles of a limb with great neatness and minuteness, and then throw it away, without any examination of the ligaments, the knowledge of which, in a surgical point of view, is of infinitely greater importance; and from hence arise the numerous errors of which they are guilty, when they embark in the practice of their profession; for, the injuries of the hip, elbow, and shoulder, are scarcely to be detected, but by those who possess accurate anatomical information. Even our hospital surgeons, who have neglected anatomy, mistake these accidents; for I have known the pulleys applied to an hospital patient, in a case of a fracture of the neck of the thigh-bone, which had been mistaken for a dislocation, and the patient cruelly exposed, through the surgeon's ignorance, to a violent and protracted extension. It is therefore proper, that the form of the ends of the bones, their mode of articulation, the ligaments by which they are connected, and the direction in which the larger muscles act, should be well understood." (*Surgical Essays*, part i. p. 2.)

The most important differences of luxations are: — 1. With respect to the articulation, in which these accidents take place; 2. The extent of the dislocation; 3. The direction in which the bone is displaced; 4. The length of time the displacement has continued; 5. The circumstances, which accompany it, and which make it simple or compound; and lastly, 6. With respect to the causes of the accident.

1. Every kind of joint is not equally liable to dislocations. Experience proves, indeed, that in the greater part of the vertebral column, luxations are absolutely impossible, unless there be also a fracture, the pieces of bone being articulated by extensive, numerous surfaces, varying in their form and direction, and so tied together by many powerful elastic means, that very little motion is allowed. Experience proves, also, that the strength of the articulations of the pelvic bones can scarcely be affected by enormous efforts, unless these bones be simultaneously fractured. Boyer has therefore set down luxations of joints with continuous surfaces as impossible. (*Traité des Mal. Chir.* t. iv. p. 17.) And, Sir A. Cooper observes, that, in the spine, the motion between any two bones is so small, that dislocations hardly ever occur, except between

the first and second vertebræ, although the bones are often displaced by fracture (*Surgical Essays*, p. 14.); and sometimes the articulating processes may be luxated after one of the bodies has given way.

In articulations with contiguous surfaces, the facility with which dislocations happen, depends upon the extent and variety of motion in such joints. Thus, in the short bones of the carpus, and particularly of the tarsus, and at the carpal and tarsal extremities of the metacarpal and metatarsal bones, where flat broad surfaces are held together by ligaments, strong, numerous, and partly interarticular, and where only an obscure degree of motion can take place; dislocations are unfrequent, and can only be produced by uncommon violence. It is in the loose joints, which admit of motion in every direction, that dislocations most frequently occur; as is exemplified in the joint of the humerus with the scapula. On the contrary, the ginglymoid joints, which allow motion only in two directions, are not so often dislocated. The articular surfaces of the latter are of great extent; and, consequently, the heads of the bones must be pushed a great way in order to be completely dislocated; and the ligaments are numerous and strong.

2. With respect to the extent of dislocation, luxations are either *complete* or *incomplete*. The latter term is applied, when the articular surfaces still remain partially in contact. Incomplete dislocations can scarcely happen except in ginglymoid articulations, as those of the foot, knee, and elbow. In these, the luxation is generally incomplete; and very great violence must have operated, when the bones are completely dislocated. In the elbow, the dislocation is sometimes partial, with respect to the ulna and radius. In the orbicular articulations, luxations are usually complete. However, "the os humeri sometimes rests upon the edge of the glenoid cavity, and readily returns into its socket." (*A. Cooper, Essays*, part i. p. 14.) The lower jaw is sometimes partially dislocated in a manner different from what is commonly meant by this expression, viz. one of its condyles is luxated, while the other remains in its natural situation.

A partial dislocation somtimes occurs at the ankle-joint. "An ankle was dissected at Guy's, and given to the collection of St. Thomas's, which was partially dislocated: the end of the tibia rested still in part upon the astralagus; but a large portion of its surface was seated on the os naviculare, and the tibia, altered by this change of place, had formed two new articular surfaces, with their faces turned in opposite directions towards the two bones. The dislocation had not been reduced." (*Sir A. Cooper.*)

3. In the orbicular joints, the head of the bone may be dislocated at any point of their circumference; and the luxations are named accordingly *upward*, *downward*, *forward*, and *backward*. In the ginglymoid articulations, the bones may be dislocated either laterally, or forward, or backward.

4. The length of time a dislocation has existed makes a material difference. In general, recent dislocations may be easily reduced; but when the head of a bone has been out of its place several days, the reduction becomes exceedingly difficult; and, in older cases, often impossible. The soft parts, and the bone itself, have acquired a certain position; the muscles have adapted themselves in length to the altered situation of the bone, to which they are attached, and, sometimes, cannot be lengthened sufficiently for it to be reduced. Indeed, I believe, that Sir Astley Cooper's statement is quite correct, that the difficulty in the reduction, arising from the muscles, is proportioned to the length of time that has elapsed from the period of the accident. (*On Dislocations*, p. 26.)

Desault and Boyer suspected, that frequently the opening in the capsular ligament soon becomes closed, and resists the return of the head of the bone into its original situation. However, with regard to the doctrine of the reduction being at first ever prevented by this cause, I believe with Sir Astley Cooper, that it is destitute of foundation. (*Surgical Essays*, part i. p. 18.; and *Treatise, &c* p. 25.) Thus, in Mr. Thompson's dissection of a dislocated humerus, the capsular ligament was completely torn from the whole circumference of the humerus. In one of Mr. Crampton's cases, it was detached to the extent of more than half the circumference; and, in an instance of direct dislocation forwards, the rent was of sufficient extent, "but no more, to permit the head of the bone to pass easily through it." (See *Thompson, in Med. Obs. and Inq.* vol. ii. p. 349. *Ph. Crampton, in Dublin Journ. of Med. Science*, vol. iii. p. 47—49.)

5. The difference is immense, in regard to the danger of the case, arising from the circumstance of a dislocation being attended, or unattended, with a wound, communicating, internally with the joint, and externally with the air. When there is no wound of this kind, the danger is generally trivial, and the dislocation is termed *simple*: but should there be such a wound, together with the dislocation, the case is denominated *compound*, and is frequently accompanied with peril. Indeed, the latter kind of accident sometimes renders amputation necessary, and, in too many instances, has a fatal termination.

6. The causes of dislocations are external or internal. A predisposition to such accidents may depend on circumstances natural, or accidental. The great latitude of motion, which the joint admits of; the little extent of the articular surfaces; the looseness and fewness of the ligaments; the lowness of one side of the articular cavity, as the anterior and inferior part of the acetabulum; and the shallowness of the cavity, as of that of the scapula; are natural predisposing causes of luxations.

A paralytic affection of the muscles of a joint, and a looseness of its ligaments, are also predisposing causes. When the deltoid muscle has been paralytic, the mere weight of the arm has been known to cause such a lengthening of the capsular ligament of the shoulder-joint, that the head of the os brachii descended two or three inches from the glenoid cavity.

Two cases, illustrative of the tendency to dislocation from a weakened, or paralytic state of the muscles, are recorded by Sir A. Cooper. The first is that of a junior officer of an India ship, who, for some trifling offence, had been placed with his foot upon a small projection on the deck, while his arm was kept forcibly drawn up to the yardarm for an hour. "When he returned to England, he had the power of readily throwing that arm from its socket, merely by raising it towards his head; but a very slight extension reduced it. The muscles were wasted, also, as in the case of paralysis." The other example happened to a young gentleman, troubled with a paralytic affection of his right side from dentition. "The muscles of the shoulder were wasted, and he had the power of throwing his os humeri over the posterior edge of the glenoid cavity of the scapula, from whence it became easily reduced." In these cases, no laceration of the ligaments could have occurred, and the influence of the muscles in preventing dislocation, and in impeding reduction, is exemplified. (*Surgical Essays*, part i. p. 10.) Mr. Brindley, of Wink Hill, communicated to Sir A. Cooper an account of a dislocation of the os femoris, which the patient, a man of 50, is able to produce and reduce whenever he chooses. One of my pupils gave me an account of a similar case in another part of the country.

The looseness of the ligaments sometimes makes the occurrence of dislocations so easy, that the slightest causes produce them. Some persons cannot yawn, or laugh, without running the risk of their lower jaw being luxated. Collections of fluid within the knee, causing a relaxation of the ligament of the patella, are often followed by a dislocation of that bone. And, whenever a bone has been once dislocated, it ever afterwards has a tendency to be displaced again by a slighter cause, than what was first necessary to produce the accident. This tendency likewise increases with every new displacement.

Diseases, which destroy the cartilages, ligaments, and articular cavities of the bones, may give rise to a dislocation. The knee is sometimes, but not frequently, partially luxated in consequence of disease; and the thigh is now and then dislocated in consequence of the acetabulum and ligaments being more or less destroyed. Such dislocations are termed *spontaneous*.

At St. Thomas's Hospital, there is a preparation of a knee, dislocated in consequence of ulceration, and in the state of anchylosis, the leg forming a right angle with the femur directly forwards. (See *Sir A. Cooper's Surg. Essays*, part i. p. 11.)

An enarthrosis joint can only be dislocated by external violence; a blow, a fall, or the action of the muscles, when the axis of the bone is in a direction more or less oblique with respect to the surface with which it is articulated.

Any external force may occasion a dislocation of ginglymoid joints, which case is generally incomplete; but in the ball and socket articulations, the action of the muscles sometimes has a share in producing the accident. So, when a person falls on his elbow, while his arm is raised outwards from his side, the force, thus applied, will undoubtedly contribute to push the head of the os brachii out of the glenoid cavity, at the lower and internal part. Still, the sudden action of the pectoralis major, latissimus dorsi, and teres major, which always takes place from the alarm, will also aid in pulling the head of the bone downwards. Under certain circumstances, the action of the muscles alone may produce a dislocation, without the conjoint operation of any outward force, as is commonly exemplified in the lower jaw, and in some dislocations of the patella. But, in other cases, when the patient is aware in time of the violence which is about to operate, and his muscles are prepared for resistance, a dislocation cannot be produced without the greatest difficulty, (*Sir A. Cooper, Op.* cit. p. 15.) unless the posture of the member at the moment be such as to render the action of the strongest muscles conducive to the displacement, instead of preventive of it, as is frequently the case in luxations of the shoulder.

Dislocations are constantly attended with more or less laceration or elongation of the ligaments; and in the shoulder and hip, the capsules are always torn, when the accident is produced by violence. Some instances, in which the ligaments are only lengthened and relaxed, I have already quoted. Sometimes a dislocation is attended with a fracture: mostly when the ankle is luxated, the fibula is broken; and in dislocation at the hip, the acetabulum may be fractured. (*Sir A. Cooper, Op.* cit. p. 15. *Wallace, in Dubl. Trans. of King's and Queen's College*, vol. v.)

Symptoms of Dislocations.

Every dislocation produces pain and incapacity in the limb or part; but, these are only equivocal symptoms, and cannot distinguish the case from a fracture, nor even from a simple contusion. A severe, but obtuse, pain arises from the pressure of the head of the bone upon the muscles; sometimes the pain is rendered more acute by the pressure being made upon a large nerve. (*Sir A. Cooper's Treatise*, p. 5.)

In order that a dislocation of the hip or shoulder may happen, there must be a particular attitude of the limb during the action of the external violence. Indeed the displacement can hardly occur from the direct action of the cause on the articulation itself. The force always acts with greater effect; the further it is from the joint, and the longer the lever is, which it affects. Thus, in a fall on the side, when the arm, raised considerably from the trunk, has to sustain all the weight of the body on a point at its inner side, the probability of a dislocation is evident, and even that the head of the bone has been forced through the lower portion of the capsular ligament.

The symptoms, which Boyer terms positive, deserve to be well remembered.

1. In dislocations of orbicular joints, and complete luxations of ginglymoid joints, the articular surfaces are not at all in contact, and the point, where the dislocated bone is lodged, cannot be upon the same level with the centre of the cavity, from which it has been forced. Hence a change in the length of the limb. In the ginglymoid joints, such alteration can only be a shortening proportioned to the extent of the displacement. But, in the orbicular joints, the bone may be displaced and carried above, or below, the articular cavity, so that, in the first event, a shortening, in the second, an elongation of the limb, will be produced. But as the direction of the member is at the same time altered, it is not always practicable to place the limbs parallel together, nor to bring them near the trunk, for the purpose of judging whether they are lengthened or shortened. A comparison, however, made without this advantage, will generally enable the surgeon to form a correct opinion. The proper length of a dislocated limb cannot be restored, except by putting the bone back into the cavity, from which it has slipped. In general, this cannot be accomplished without considerable efforts, while a slight exertion is usually sufficient to restore the proper length of the

limb in cases where the shortening depends upon a fracture. Also when once the natural length of the limb has been restored in dislocations, it remains; while, in fractures, the shortening recurs as soon as the extension is discontinued. As for elongation of the limb, it can never happen in cases of fracture, as it does in certain dislocations.

2. In many cases, the direction of the axis of the limb is unavoidably altered. This circumstance arises from the resistance of that portion of the articular ligaments, which has not been ruptured, as well as from the action of the muscles. In dislocation of orbicular joints, the tension of certain muscles, is a cause of a rotatory movement of the dislocated limb at the moment of the displacement, and which it afterwards retains. Thus in dislocations of the thigh bone at the hip, the toes, and knee are turned outward or inward, according as the head of the bone happens to be situated at the inside, or outside of the joint. The alteration in the length of the part, and in its position generally, is permanent when it depends upon a dislocation; whereas in fractures the same changes occur, but can be made to cease at once, without any particular effort.

3. The absolute immobility of a limb, or, at least, the inability of performing certain motions, is amongst the most characteristic symptoms of a dislocation. In complete luxations of some ginglymoid joints, the dislocated limb is absolutely, or very nearly, incapable of any motion. Thus, in the dislocation of the forearm backwards, the particular disposition of the bones, and the extreme tension of the extensor and flexor muscles, confine the limb in the half-bent state, and at the same time resist every spontaneous motion, and likewise almost every motion which is communicated. In the orbicular joints, the painful tension of the muscles, which surround the luxated bone, nearly impedes all spontaneous movements; but, in general, analogous motions to that, by which the displacement was produced, can be communicated to the limb, though not without exciting pain. Thus, in the dislocation of the humerus downward, the elbow hardly admits of being put near the side, nor of being carried forward, and backward; but it can easily be raised up. In the dislocation of the acromial end of the clavicle, the patient can bring the arm towards the trunk, separate it a little from the side, or carry it forward or backward; but he cannot raise it in a direct way. Lastly, in complete lateral dislocations of such joints as have alternate motions, the patient has the power of performing no motion of the part; but, the complete destruction of all the means of union allows the limb to obey every species of extraneous impulse.

Sometimes, as Sir A. Cooper has remarked, a considerable degree of motion continues for a short time: thus, in a man, brought into Guy's Hospital, whose thigh-bone had just been dislocated into the foramen ovale, a great mobility of the femur still remained; but, "in less than three hours, it became firmly fixed in its new situation by the contraction of the muscles." (*Surgical Essays*, part i. p. 3.)

4. In dislocations attended with elongation of the limb, the general and uniform tension of all the muscles arranged along it, gives to these organs an appearance as if they lay nearer the circumference of the bone, and the limb were smaller than its fellow. The muscles, however, which belong to the side, from which the dislocated bone has become more distant, appear tenser and harder. On the contrary, in dislocations, where the limb is shortened, the muscles are relaxed; but being irritated, they contract and accommodate themselves to the shortened state of the limb. Hence, the extraordinary swelling of their fleshy part, and the manifestly increased diameter of the portion of the member to which they belong. We have a striking example of this in the dislocation of the thigh upward and outward, where the muscles at the inner side of the limb form a distinct oblong tumour. In dislocations of the thigh, the glutæus maximus on the same side is flattened, if the bone is carried inward; but it is more prominent, when the thigh-bone is carried outward; and its lower edge is situated higher, or lower, than in the natural state, according as the luxation may have taken place upward or downward. In the complete luxation of the forearm backward, the triceps is tense, and forms a cylindrical prominence, owing to the displacement of the olecranon backward.

The form of the joints principally depends upon the shape of the heads of the bones. Hence, the natural relation of the bones to each other cannot be altered, without a change being immediately produced in the external form of the joint. The changes, which the muscles, passing over the luxated joint, at the same time undergo in their situation and direction, contribute likewise to destroy the harmony of the outlines of the limb.

When the head of a bone has slipped out of the articular cavity, it may often be felt in its new situation, while at the articulation itself may be remarked a flatness caused by one of the neighbouring muscles stretched over the articular cavity, and more deeply the outline and depression of this cavity itself can be perceived. The bony eminences, situated near the joint, and whose outlines were gradually effaced in the general form of the member, are sometimes rendered more apparent by the displacement, and project, in a stronger degree, than in the natural state, while, in other instances, they project less, and become more concealed. On this part of the subject, Sir A. Cooper is particularly correct, when he observes, that the head of the bone can generally be felt in its new situation, excepting in some of the dislocations of the hip, and its rotation is often the best criterion of the accident. *The natural prominences of bone, near the joint, either disappear, or become less conspicuous, as the trochanter at the hip-joint. Sometimes the reverse occurs; for in dislocations of the shoulder, the acromion projects more than usual.* (*Surg. Essays*, part i. p. 4.)

The lines, made by the contour of the limb, and the natural relation of the bones, are so manifestly broken in dislocations of ginglymoid joints, that, when there is no inflammatory swelling, the case is at once manifest. More certain knowledge, however, and more correct information, respecting the kind of displacement, are to be obtained, by attentively examining the changes of position, which certain processes, or prominent points of the dislocated bone, or bones, have undergone, and which are the more obvious in these joints, inasmuch as they give attachment to the principal muscles. The natural relations of these processes being known, the least error of situation ought to strike the well-informed practitioner. Thus, in the elbow-joint, a considerable difference in the respective height, and in the distances between the olecranon and internal and external condyles, can be easily distinguished. But, the thing is less easy, when the surrounding parts are so swelled and tense, as to make the bony projections deeper from the surface, and less obvious to examination. Even then, however, a good surgeon will at least find something to make him suspect the dislocation, and the suspicion will be confirmed, when he again examines the part after the swelling has begun to subside. It is of the utmost consequence to make out, what the case is as early as possible; for the unnatural state, in which the soft parts are placed, keeps up the swelling a long while; and if the surgeon wait till this has entirely subsided, before he ascertains that the bones are luxated, he may have waited till it is too late to succeed in reducing them, and the patient may remain for ever afterwards deprived of the free use of his limb. (*Boyer, Traité des Maladies Chir.* t. v. p. 45, &c.) It is not only the inflammatory swelling, which may tend to conceal the ends of the bone; sometimes a quicker tumour arises from the effusion of blood in the cellular tissue, and causes an equal difficulty of feeling the exact position of the heads of the bones. (See *Sir A. Cooper on Dislocation*, p. 5.)

Dislocations are sometimes attended with particular symptoms, arising altogether from the pressure caused by the head of the luxated bone on certain important organs. Thus, the sternal end of the clavicle may compress the trachea, and impede respiration; the head of the humerus may press upon the axillary plexus of nerves, and produce a paralytic affection of the whole arm. In one instance, cited by Sir A. Cooper, a dislocated clavicle pressed upon the œsophagus, and endangered life. (*Surg. Essays*, part i. p. 4.)

As Kirkland has observed, some luxations are worse injuries than fractures: of this description, are dislocations of the vertebræ, cases which seldom happen without fracture, and are mostly fatal; dislocations of the long bones, attended with protrusion of their ends through the skin, and even a comminution of them; and followed by severe inflammation, extensive abscesses, necrosis, and not unfrequently gangrene.

According to Sir A. Cooper, young persons are rarely the subjects of dislocations from violence; but, he admits, that they do sometimes experience them, and relates an instance, which happened in a child seven years of age. In general, in them the bones break, or the epiphyses give way, much more frequently than the articular surfaces are displaced. (*Surg. Essays*, part i. p. 16.; and *Treatise, &c.* p. 23.) Suspected luxations of the hip in children commonly turn out to be disease of the joint, one instance of which is given by the preceding author. For such examples I have also been sometimes consulted. Also, when a dislocation of the elbow is suspected in a child, because the bone appears readily to return into its place, but directly to slip out of it again, the case is always found to be an oblique fracture of the condyles of the humerus. Old persons are less liable to dislocation, than individuals of middle age; a fact, which is accounted for by the extremities of bones in old subjects being so softened, that the violence sooner breaks than luxates them. (*Sir Astley Cooper, on Disloc., &c.* p. 23.)

Prognosis.

In general, every unreduced dislocation must deprive the patient more or less of the use of the limb or part; for nature cannot re-establish the natural relations which are lost. There is indeed an effort made to restore some of the motions, and the use of the limb in a certain degree; but it is always imperfectly accomplished, and, in the best cases, only a confined degree of motion is recovered. Nature cannot in any way alter the lengthened or shortened state of the limb; and she can only correct, in a very imperfect manner, its faulty direction. There are even some cases, in which little or no amendment can be effected.

If there are any exceptions to these observations, they are in young subjects, or in arthrodia joints, which are seldom extensively displaced; and as, in the natural state, their motions are but limited, the loss of these motions, in consequence of the natural relations not having been restored, is of less importance. Thus, the bones of the carpus, those of the tarsus, and the acromial end of the clavicle, may be dislocated, and be reduced either imperfectly, or not at all, without the functions of the limb being materially impaired. (*Boyer, Maladies Chir.* t. iv. p. 54.) Generally, however, after a time, some degree of motion is regained, and the limb, or part, becomes to a certain extent more useful, than at first. This statement applies even to dislocations of the hip, shoulder, lower jaw, elbow, thumb, &c.

Dislocations of enarthrosis joints are generally much less dangerous, than those of ginglymoid ones; for the action of the muscles has some share in producing them; the violence done to the external parts is less; and the injury of the soft parts is not so considerable. Even, in the same kind of joints, the seriousness of the case materially depends on the extent of the articular surfaces, and the number and strength of the muscles and ligaments.

Dislocations of ginglymoid joints, however, are more easily reduced, than those of enarthrosis ones, the muscles of which are powerful, and capable of making great resistance to the efforts of the surgeon. This is frequently exemplified in luxations of the shoulder and thigh.

It may be said, however, of the luxations of enarthrosis joints, that, although their reduction may require considerable efforts, yet it can be accomplished, and that the accident leaves no ill effects. On the contrary, in dislocations of ginglymoid joints, the same reason, which renders them more unfrequent, makes them also more serious. The solidity of these joints prevents the uniting means from being destroyed, except by great violence: and the extent of the articular surfaces does not permit a considerable displacement, especially a complete one, without extensive injury of the ligaments, and surrounding soft parts. It is for these reasons, no doubt, that compound luxations and protrusion of the heads of the bones are most commonly seen in ginglymoid articulations.

The more recent a luxation is, the more easy it is to reduce, and therefore, *cæteris paribus*, the less grave is the injury. In this point of view, dislocations of ginglymoid joints are the most serious, because they sooner become irreducible than those of enarthrosis articulations.

Simple dislocations are much less dangerous, than those, which are complicated with contusion, the injury of a large nerve or blood-vessel, inflammatory swelling, fracture, wound, and, especially, a protrusion of the end of the bone. (*Boyer, Maladies Chir.* t. iv. pp. 55, 56.)

Dislocations from disease of the parts of bones, entering into the formation of the joints, termed *spontaneous luxations*, cannot admit of reduction: when they arise from the hip-disease, it is not merely in consequence of the ligaments being destroyed, parts of the acebutalem itself are more or less absorbed. However, there are other *spontaneous* dislocations from preternatural looseness of the ligaments, where reduction may be accomplished with the greatest facility; though the displacement generally recurs from slight causes.

Mr. Wallace has made some interesting pathological remarks on dislocations, deduced from the dissection of an unreduced dislocation of the head of the femur on the dorsum ilii, accompanied by a fracture of the superior edge of the acetabulum, which formed part of the new articular surface. The case confirmed one point, which indeed was previously well known; namely, that when a bone is allowed to remain unreduced, and in such a situation, that the natural movements of the limb are prevented or restricted, its muscles become diminished in size, or wasted. Mr. Wallace's case demonstrated further, however, that such atrophy affects the external rotator muscles in a greater degree than others, in consequence of their action having been rendered almost impossible by the existence of check ligaments extended from the ilio-pubic sypmhysis to the lesser trochanter.

Mr. Wallace likewise notices the fact, that if, at the time of dislocation, a tendon be torn across at its junction with the muscle, the detached ends of the muscular fibres become connected with those parts, with which they may be brought in contact. In the case adverted to, this had happened to the pyriformis.

Mr. Wallace next explains, that, if, the fleshy fibres of a muscle be torn through, they reunite by a tendinous tissue. This fact was exemplified in the gemini and quadratus. If a muscle be so torn, or injured, as to render its reunion by tendon impracticable, its entire texture becomes changed, or rather the muscle is absorbed, and "there is deposited in its place a substance of a peculiar texture, resembling a mixture of adeps and fibro-cartilage." In the case referred to, this had happened to the obturator internus.

Another circumstance, exemplified in this instance, was, that, when the distance between the points of attachment of a muscle, is either increased, or diminished, the muscular fibre has the power of undergoing such changes of shortening, or elongation, as may be necessary to adapt itself to its new state. "The triceps femoris, and some others, were in this case, shortened; and the quadratus and gemini were elongated."

"When any of the ligaments of a joint have been torn during the act of dislocation, if the bone be allowed to remain in such a situation, that the torn ligaments can no longer serve any useful purpose, they are completely absorbed, and disappear, or they are converted into cellular tissue, and become confounded with the surrounding parts. Thus, in the present case, there were not the slightest remains of the round ligament.

"In all complete dislocations of the enarthrodial joints, the capsular ligament must necessarily be ruptured. If the bone be returned into its natural situation, the laceration is quickly repaired; but, if the displacement be allowed to continue, a perfect capsule will be formed round the new joint, and the original lacerated capsule will contribute to form a greater or a smaller portion of this new capsule, according to the situation of the parts." Mr. Wallace deems it probable, that, in his case, the capsule was lacerated, although the dislocation was only partial in consequence of a part of the acetabulum having been broken off. "Yet (says he) of this laceration, there was not any appearance. The new capsule was remarkable for its great thickness; but it was not formed of those regular fibres, which enter into the formation of the original capsule;" and "although its inner surface had the power of secreting synovia, it did not exhibit the smooth, shining aspect of synovial membrane."

According to Mr. Wallace's investigations, nature does not possess the power of forming articular cartilage in those accidental joints, which result from unreduced dislocations. "The new articular surfaces are always covered by a lamina of bone, which resembles in appearance that ivory-like substance, sometimes found on natural articulating surfaces. As a cartilaginous surface cannot play easily on a bony surface, the original cartilage, which may have covered the head of the dislocated bone, becomes absorbed, and its situation occupied by the same kind of tissue, as that which forms the new surface, upon which the head of the bone may be applied." Another thing, noticed by Mr. Wallace, is the alteration of the articular cavity, in consequence of the removal of the head of the bone. It becomes contracted in size and altered in form; and "the cartilage, which formerly covered its surface, disappears, being replaced by ligamentous fibres, which grow at right angles from the surface of the bone, and these extending outwards, become confounded with the surrounding parts."

Mr. Wallace finally adverts to the wonderful facility, with which the osseous tissue, apparently unyielding as it is, adapts itself to varied states. "At one time, we find it so completely removed, that not a vestige of large masses of it remains; and, on other occasions, great additions are made to the original bone to serve useful purposes. Again, without either increase, or diminution of the quantity of osseous matter, we find the bone to be, as it were, so completely new modelled, that its acquired shape has scarcely any resemblance to its former figure. In the present dissection, the acetabulum was nearly removed; a new plate of bone for the formation of an articulating surface was deposited on the ilium, and the head of the femur was completely remodelled." (See *Wallace* in *Trans. of King's and Queen's College, Dublin*, vol. v. p. 250, &c.)

When the head of a bone is thrown and left for a certain time upon a thick stratum of muscular fibres, a new capsular ligament may form for its enclosure; but, when it is thrown upon a thin layer of muscle, or upon the surface of a bone the muscle may be absorbed, and a new bony socket, or cavity, be produced, as explained by Sir Astley Cooper. Even when the humerus has been thrown forwards on the ulna, new osseous deposits are sometimes arranged in such a manner on the latter as to constitute an articular cavity for the reception and support of the lower end of the humerus. Of this, there is an interesting representation given by Cruveilhier. (See *Anat. Pathologique.*) Sometimes, when the upper head of the humerus remains dislocated in the axilla, a new articular cavity is formed for it below the neck of the scapula.

Treatment of Dislocations in general.

It was correctly explained by Pott, that the difficulty, which attends the reduction of luxated joints, principally arises from the resistance of the muscles. "The mere bones composing the articulations, or the mere connecting ligaments, would in general afford very little opposition; and the replacing the dislocation would require very little trouble or force, was it not for the resistance of the muscles and tendons attached to and connected with them: for, by examining the fresh joints of the human body, we shall find, that they not only are all moved by muscles and tendons, but also, that although what are called the ligaments of the joints do really connect and hold them together, in such manner as could not well be executed without them; yet in many instances, they are, when stript of all connection, so weak and lax, and so dilatable, that they do little more than connect the bones and retain the synovia; and that the strength, as well as the motion, of the joints depends, in great measure, on the muscles and tendons connected with and passing over them; and this in those articulations which are designed for the greatest quantity, as well as for celerity, of motion. Hence, muscles require our first and greatest regard, these being the parts, whose resistance must be either eluded or overcome. (See *Potts's Chir. Works*, vol. i.)

That the muscles are the chief cause of resistance is proved by cases, in which the dislocation is accompanied with injury of a vital organ; for, then the bone may be reduced by a very slight force. Thus, in a man, who had an injury of his jejunum, and a dislocation of his hip, the bone was most easily replaced. (*Sir A. Cooper, Surgical Essays*, part i. p. 20.) In short, any thing, which produces faintness or weakness, facilitates the reduction, as intoxication, nausea and sickness, paralysis, &c.

The following are some of the principles laid down by Pott:—

1. Although a joint may have been luxated by means of considerable violence, it does by no means follow, that the same degree of violence is necessary for its reduction.

2. When a joint has been luxated, at least one of the bones, of which it is composed, is detained in that unnatural situation by the action of some of the muscular parts in connection with it; which action is not under the direction of the will of the patient.

3. That all the force used in reducing a luxated bone, ought always to be applied to the other extremity of the said bone, and as much as possible to that only. Mr. Pott argues, that if the extending force were applied to a distant part of the limb, or to the bone below or adjoining, it would necessarily be lost in the articulation which is not luxated, owing to the yielding nature of the ligaments, and be of little or no service, in that which is dislocated. This remark, though made by Pott, and generally received as true, is incorrect; for it tends to state, that if extension be made at the ankle or wrist, the force does not operate on the hip or shoulder.

4. That in order to make use of an extending force with all possible advantage, and to excite thereby the least pain, and inconvenience, it is necessary that all parts serving to the motion of the dislocated joint, or in any degree connected with it, be put into such a state as to give the smallest possible degree of resistance.

5. That in the reduction of such joints as consist of a round head, moving in an acetabulum or socket, no attempt ought to be made for replacing the said head, until it has by extension been brought forth from the place where it is, and nearly to a level with the said socket. This will show us, says Mr. Pott, a fault in the common ambi, and why that kind of ambi, which Mr. Freke called his commander, is a much better instrument than any of them, or indeed than all; because it is a lever joined to an extensor, and that capable of being used with the arm, in such a position as to require the least extension, and to admit the most; besides which it is graduated, and therefore perfectly under the dominion of the operator; it will show us, why the old method by the door or ladder sometimes produced a fracture of the neck of the scapula; as Mr. Pott saw it do himself. Why, if a sufficient degree of extension be not made, the towel over the surgeon's shoulder, and under the patient's axilla, must prove an impediment rather than an assistance, by thrusting the head of the humerus under the neck of the scapula, instead of directing it into its socket. Why the bar, or rolling-pin, under the axilla produces the same effect. Why the common method of bending the os humeri downward, before sufficient extension has been made, prevents the very thing aimed at, by pushing the head of the bone under the scapula.

6. That whatever kind or degree of force may be found necessary for the reduction of a luxated joint, that such force be employed gradually; that the lesser degree be always first tried, and that it be increased gradatim. (See *Pott's Chir. Works*, vol. i.)

The supposition of the reduction being sometimes prevented by the capsular ligaments, Sir A. Cooper considers erroneous; in dislocations from violence, those ligaments are always extensively lacerated; and the idea of the neck of the bone being girt, or confined by them, is altogether untrue. (*Surg. Essays*, part i. p. 18.) But, in addition to the resistance of the muscles, there are, in old dislocations, three circumstances pointed out by Sir A. Cooper as causes of the difficulty of reduction: — 1. The extremity of the bone contracts adhesion to the surrounding parts, so that in dissection, even when the muscles are removed, the bone cannot be reduced. In this state, he found the head of a radius, which had been long dislocated upon the external condyle, and which is preserved in the collection of St. Thomas's Hospital. In a similar state, he has also seen the dislocated head of the humerus. (*On Dislocations*, p. 28.) 2. The socket is sometimes filled up with adhesive matter. 3. A new bony socket is sometimes formed, in which the head of the bone is so completely confined, that it could not be extricated without breaking its new lodgment. (*Surgical Essays*, part i. p. 21.; and *Treatise*, &c. p. 10.)

Dislocations in general cannot be reduced without trouble; but, after the reduction is accomplished, it is easily maintained. On the contrary, fractures are for the most part easy of reduction; but cannot be kept in this desirable state without difficulty. The moment extension is remitted, the muscles act, the ends of the broken bone slip out of their proper situation with respect to each other, and the distortion of the limb recurs. As a modern writer has observed, the reduction is only a small part of the treatment of fractures: the most essential point of it, is the almost daily care which a fracture demands, during the whole time requisite for its consolidation. The contrary is the case in luxations. Here, in fact, the reduction is every thing, if we put out of consideration the less frequent cases, in which the dislocation is complicated, and attended with such grave circumstances, as render it indispensably necessary to continue for a length of time the utmost surgical care. But, even then, the protracted treatment is less for the dislocation itself, than for the extraordinary circumstances, with which it is accompanied. (See *Roux, Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise,* p. 207.)

All the ancient writers recommend the extending force to be applied to the luxated bone; for instance, above the knee in dislocations of the thigh-bone, and above the elbow in those of the humerus. We have stated, that Pott advised this plan, and the same practice, which is approved by J. L. Petit, Duverney, and Callisen, is generally adopted in this country.

However, many of the best modern surgeons in France, for instance, Fabre, D'Apouy, Desault, Boyer, Richerand, Leveillé, and Dupuytren, advise the extending force not to be applied on the luxated bone, but, on that with which it is articulated, and as far as possible from it. It is said, that this plan has two most important advantages: — first, The muscles, which surround the dislocated bone, are not compressed, nor stimulated to spasmodic contractions, which would resist the reduction; secondly, The extending force is much more considerable, than in the other mode; for, by using a long lever we obtain a greater degree of power.

In Pott's remarks, we find even him influenced against the latter practice, by the supposition, that part of the extending force is lost on the joint, intervening between the dislocation, and the point at which the extension is made; a notion quite unfounded, as every man who reflects for one moment, must soon perceive. When extension is made at the wrist, the ligaments, muscles, &c. which connect the bones of the forearm with the os brachii, have the whole of the extending force operating on them, and they must obviously transmit the same degree of extension, which they receive, to the bone above, to which they are attached. Indeed, this matter seems so plain, that I think it would be an insult to the reader's understanding to say any more about it, than that such eminent surgeons, as have contrary sentiments, can never have taken the trouble to reflect for themselves on this particular subject. Whether the force, necessary to be exerted in some instances, would have a bad effect on the intervening joint, may yet be a question; but, as Desault's and Dupuytren's practice was extensive, and they did not find any objection of this kind, we have no right to conclude that such would exist.

If, however, the common objection to Desault's plan of applying the extending force be unfounded, the question still remains to be settled, whether this practice is most advantageous on the grounds above specified. This is a point, which, perhaps, cannot be at once peremptorily decided altogether in the negative, or the affirmative, since what may be best in one kind of dislocation, may not be so in another. Thus, Sir A. Cooper states, that, so far as he has had an opportunity of observing, it is generally best to apply the extension to the bone, which is dislocated: but, that dislocations of the shoulder are exceptions, in which he mostly prefers to reduce the head of the bone by placing his heel in the axilla, and drawing the arm at the wrist, in a line with the side of the body, whereby the pectoralis major and latissimus dorsi are kept in a relaxed state. (*Surgical Essays,* part i. p. 25.)

Extension may either be made by means of assistants, who are to take hold of a napkin, tablecloth, or sheet, folded longitudinally, and put round the part, at which it is judged proper to make the extension; or else a multiplied pulley may be used. In cases of difficulty, Sir A. Cooper deems the pulley preferable. "When assistants are employed, their exertions are sudden, violent, and often ill-directed, and the force is more likely to produce laceration of parts, than to restore the bone to its situation. Their efforts are also often uncombined, and their muscles are necessarily as fatigued, as those of the patient, whose resistance they are employed to overcome." In dislocations of the hip-joint, and in those of the shoulder which have been long unreduced, pulleys should always be employed. (*Surgical Essays,* part i. p. 24.) But, whether pulleys be used or not, nothing more need be added to what Mr. Pott has stated, concerning the propriety of using moderate force in the first instance, and increasing the extending power very gradually.

In order to measure the force used in the extension with pulleys, M. Malgaigne has invented and repeatedly used an instrument, termed a *dynanometer.* Mr. Weiss was kind enough to shew me, some time ago, one which he has constructed; and Mr. Crosse informs us, that he has procured one, which seems to answer every purpose.

The extension should always be first made in the same direction, in which the dislocated bone is thrown; but, in proportion as the muscles yield, the bone is to be gradually brought back into its natural position. Thus the head of the bone becomes disengaged from the parts, among which it has been placed, and is brought back to the articular cavity again by being made to follow the same course, which it took in escaping from it.

Extension will prove quite unavailing, unless the bone, with which the dislocated head is naturally articulated, be kept motionless by *counter-extension,* or a force at least equal to the other, but made in a contrary direction.

The mode of fixing the scapula and pelvis, in luxations of the shoulder and thigh, will be hereafter described.

In dislocations of ginglymoid joints, extension and counter-extension are only made for the purpose of diminishing the friction of the surfaces of the joints, so that the reduction may be rendered more easy.

When the attempts at reduction fail, the want of success may be owing to the extension not being powerful enough, and the great muscular strength of the patient, which counteracts all efforts to replace the bone.

In the latter case, the patient may be freely bled, and put into a warm bath, so as to make him faint. The opening in the vein should be made large, because a sudden evacuation of blood is more likely to produce weakness and swooning, than a gradual discharge of it; and the patient, for the same reason, may be bled as he stands up. In difficult cases, the expedient of intoxication has been recommended, as, when the patient is in this state, his muscles are incapable of making great resistance to reduction. Under these circumstances, opium is sometimes administered with advantage.

"The means to be employed for the reduction of dislocations (says Sir Astley Cooper) are both constitutional and mechanical. It is generally wrong to employ force only, as it becomes necessary to use it in such a degree as to occasion violence and injury; and it will be shown in the sequel, that the most powerful mechanical means fail, when unaided by constitutional remedies. The power of the muscles, in the first instance, is to be duly appreciated, as this forms the principal cause of resistance. The constitutional means to be employed for the purpose of reduction are those, which produce a tendency to syncope, and this necessary state may be best induced by one or other of the following means, viz., by bleeding, warm bath, and nausea. Of these remedies, I consider bleeding the most powerful: and that the effect may be produced as quickly as possible, the blood should be drawn from a large orifice, and the patient kept in the erect position; for, by this mode of depletion, syncope is produced, before so large a quantity of blood as might injure the patient is lost. However, the activity of this practice must be regulated by the constitution of the person; for as the accident happens to all the varieties of constitution, it must not be laid down as a general rule; but when the patient is young, athletic, and muscular, the quantity removed should be considerable, and the method of taking it away that which I have described.

"Secondly, in those cases where the warm bath may be thought preferable, or where it may be considered improper to carry bleeding any farther, the bath should be employed at the temperature of 100° or 110°; and as the object is the same as in the application of the last remedy, the person should be kept in the bath at the same heat till the fainting effect is produced, when he should be immediately placed in a chair, wrapped in a blanket, and the mechanical means employed.

"Of late years, I have practised a third mode of lowering the action of the muscles, by exhibiting nauseating doses of tartarised antimony; but as its action is uncertain, frequently producing vomiting, which is unnecessary, I rather recommend its application, merely to keep up the state of syncope, already produced by the two preceding means, which its nauseating effects will most readily do, and so powerfully overcome the tone of the muscles, that dislocations may be reduced with much less effort, and at a much more distant period from the accident than can be effected in any other way." (*Sir A. Cooper on Dislocations*, &c. pp. 29, 30. Also *Surgical Essays*, part i. p. 22.) In cases of unusual difficulty, the use of antimonium tartariz. together with the warm bath and bleeding, seems rational and judicious: but, except in cases of that description, I should prefer long-continued, unremitting, not too violent, extension, which will at last overcome the muscles of the most athletic man. Sometimes the resistance made to reduction by muscles acting in obedience to the will, may be eluded by the patient's attention being suddenly taken from the injured part, at which moment the action of those muscles is suspended, and a very little effort on the part of the surgeon will reduce the bone. A case, illustrating this circumstance, is recorded by Sir A. Cooper. (*Surgical Essays*, part i. p. 25; and *Treatise*, &c. p. 34.) This principle was never neglected by Dupuytren, and it was partly by availing himself of it, that he succeeded even without the pulley in reducing not less than thirty-three dislocations of the shoulder and hip, which had continued for periods varying from a fortnight to more than three months. (See *Dupuytren, Chir. Clin.* t. i. p. 126. Also, *M. Marx, in Répertoire Général d'Anat. et de Physiologie Pathol. 1re. Trimestre*, 1829.)

Sir Astley Cooper believes, that much mischief is produced by attempts to reduce dislocations of long standing in very muscular persons. He has seen great contusion of the integuments, laceration, and bruises of the muscles, and stretching of the nerves, leading to an insensibility and paralysis of the hand follow an abortive attempt to reduce a dislocation of the shoulder. He is of opinion, that three months for the shoulder, and eight weeks for the hip, may be set down as the period from the accident, when it would be imprudent to make the attempt, except in persons of very relaxed fibre, or advanced age. (*On Dislocations*, &c. p. 35.)

Mr. Twining succeeded, however, in reducing a dislocation of the humerus in a robust healthy sailor, which had continued fifteen weeks. Gradually increased extension with the pulleys was maintained for fifty minutes, and, during that time nausea and faintness were induced by a large dose of tartar emetic, and the abstraction of lbij of blood. (See *Trans. of Med. and Phys. Soc. of Calcutta*, vol. iv. art. 8. 1829.)

A case is mentioned by Mr. Lawrence, in which he succeeded in reducing the upper heads of the radius and ulna, when they had been displaced twenty-six days; one to the outside of the external condyle of the humerus, the other directly backward, with fracture of the coronoid process. (See *Lancet* for 1830, 31, p. 445.) Mr. Crosse refers to some dislocations of the radius and ulna backwards, which had been reduced at sixty-three and even seventy days; but, in one of these cases, the olecranon was fractured in the attempt, owing to the resistance of the triceps. In five weeks, however, the patient regained the use of the limb. (See *Prov. Med. and Surg. Trans.* vol. v.) In several instances, Desault succeeded in reducing dislocations of thirty, or thirty-five days' standing, and even occasionally after an interval of two months and a half, or three months. (*Œuvr. Chir. de Desault, par Bichat*, t. i.)

The practice of Desault then was encouraging, in relation to the reduction of old dislocations. But M. Flaubert, surgeon to the Hôtel Dieu at Rouen, published five cases of an opposite tendency; for his attempts at reduction of the shoulder after eleven and fifteen days, five weeks, and seven weeks, and at reduction of the elbow joint after twenty-seven days, were ineffectual. The first patient died of rupture of the axillary artery. The second and third were seized immediately after the operation with palsy of the arm, from which the former scarcely recovered at all, and the latter but very imperfectly; consequently, the brachial nerves must have been injured. The fourth was attacked with palsy of the entire side, and died of inflammation and softening of the spinal chord in the neck produced by the four lowest branches of nerves, which form the brachial plexus, being torn out of the spinal chord by the roots. And the fifth suffered laceration of all the soft parts around the elbow joint, and probably of the arteries also, and lost entirely the use of the forearm. (See *Flaubert*, in *Répertoire Général*, &c. t. iii.) One instance, in which a woman died from the violence used in attempting to reduce a dislocated shoulder, is recorded by Sir A. Cooper. (*On Dislocations*, p. 422.)

Professor Gibson has met with two instances, in which the axillary artery, which had become firmly adherent to the head of the bone, was torn across, and the patients lost their lives. One of the dislocations had existed nine weeks; the reduction took up an hour and three quarters; and, on the following day, a swelling of an aneurismal character was noticed. The subclavian artery was taken up; but, the patient died. (See *Amer. Journ. of Med. Sciences*, No. 3. and *Amer. Ed. of this Dict. by Dr. Reese.*)

The experience of Dupuytren proves, after all, however, that old dislocations may frequently be reduced at so late a period as eighty-two days, and even more; that this may generally be accomplished without much torture to the patient; and that, with proper precautionary measures, none of the serious accidents occur which M. Flaubert met with. In every instance, the warm bath is used immediately before the attempt at reduction is made. The joint is also covered for some time previously with poultices containing laudanum, or extract of monkshood, henbane, or nightshade. If the patient is young and vigorous, bloodletting is practised once, or oftener, according to circumstances. During the operation, the surgeon takes care to distract the patient's attention by some powerful means, from the suffering which he endures, or rather dreads. The mere idea of pain, or fear, says M. Marx, causes the muscles to contract, so as to make a material impediment to the reduction. But, if care be taken, during the process of extension, and the other necessary manœuvres, to divert the patient's attention from the accident to other subjects, the muscles cease to make resistance, and the bone returns into its place. In this way they may sometimes be taken, as it were, by surprise. A material point gained by making the patient talk, is specified by a critical writer as overlooked by M. Marx: namely, besides distracting the attention, it hinders the chest from retaining that fixed state, which is necessary for every violent exertion. (See *Edinb. Med. and Surg. Journ.* No. 102. p. 185.)

In seven of Dupuytren's cases, the dislocation had existed only for a week or less. In five, it had continued fifteen or eighteen days. In three, between twenty-one and twenty-six days. In three, between thirty-one and thirty-seven days. In five, between forty-one and fifty-two days. In four, between sixty and eighty-two days. In two, for three months; and in two, for two years. In one of the last, reduction was not attempted; and, in another of seventy-six days' standing, three attempts were unsuccessfully made to reduce a dislocation of the elbow; but, in all the rest, the operation was completely successful. (See *M. Marx, in Répertoire Gén. d'Anat.* &c. 1829; also, *Dupuytren, Clin. Chir.* t. i. p. 121, &c.)

It deserves notice, that Dupuytren's own successful cases were twenty-three; that he never employed pulleys; and that, in attempting to reduce old dislocations of the shoulder, he made the extension considerably upwards, as first recommended by Charles White, of Manchester, afterwards by M. Motte, and of late years by M. Malgaigne. He always availed himself of as long a lever as he could obtain, by applying the extending means as far from the dislocated joint as was practicable. Thus, in dislocations of the shoulder, the extension was made at the wrist; in those of the hip, it was made just above the ankle.

The reduction of a dislocation is known by the limb recovering its natural length, shape, and direction, and being able to perform certain motions, not possible while the bone was out of its place. The patient experiences a great and sudden diminution of pain; and, very often, the head of the bone makes a noise at the moment when it returns into the cavity of the joint.

In order to keep the bone from slipping out of its place again, we have only to hinder the limb from moving. When splints will act powerfully in supporting the joint, they are often used, as in dislocations of the ancle, wrist, &c. As the humerus cannot be luxated, except when at some distance from the body, a return of its dislocation will be prevented by confining the arm close to the side in a sling. The spica bandage, applied after such an accident, is more satisfactory to the patient, than really efficacious. Whatever bandage is used to keep the arm from moving, should be put on the lower end of the bone, as far as possible from the centre of motion. According to Sir Astley Cooper, the hip is rarely dislocated a second time; but the humerus, and the lower jaw very frequently slip again from their sockets, which are shallow. Bandages for the prevention of this return of displacement are, therefore, in such cases, particularly necessary. Rest is required for some time after the reduction, in order that the ruptured ligaments may unite. The strength of the muscles, &c. will also be greatly promoted by friction, and pouring cold water over the limb. (*On Dislocations*, p. 35.)

When a bone is broken and dislocated, an endeavour should be made to reduce the dislocation without loss of time, and then pay attention to the fracture. Also if there be a compound fracture of the leg, and a dislocation of the shoulder, the fracture is to be secured in splints, and the dislocation then reduced. (*Sir A. Cooper on Dislocations*, p. 16.) The case of a bone, dislocated and fractured at the same time, might be attended with considerable difficulty of reduction: fortunately it is an uncommon accident.

Compound Dislocations

Mean such as are attended with a wound communicating with the cavity of the injured joint. Some joints are more disposed than others to compound dislocations. The accident scarcely ever takes place at the hip. Sir Astley Cooper has known one instance of it at the shoulder, and he has seen one of the knee; but the case is very frequent in the ankle. (*On Dislocations*, p. 19.) In most instances, the opening in the skin is caused by the protrusion of the bone, but sometimes by the part having struck against a hard or an irregular body. Cases of this description are frequently attended with great danger; and the same nicety of judgment is requisite in determining, whether amputation ought to be immediately performed, or an effort made to preserve the limb as in compound fractures, and bad gunshot injuries; and many of the observations which I shall have to offer upon the latter subjects, will be applicable to the present.

When the dislocation of a large joint is conjoined with an external wound, leading into the capsular ligament, the latter circumstance has a particular tendency to increase the danger. In many cases, injuries of this description are followed by violent and extensive inflammation, abscesses, mortification, fever, delirium, and death. When the patient is advanced in years, much debilitated, or of an unhealthy irritable constitution, a compound luxation, especially if attended with severe contusion and other injury of the soft parts, often has a fatal termination. A man, above the age of seventy, and much addicted to drinking, was brought into the North London Hospital with a compound dislocation of the first phalanx of his right thumb. The case was reduced; but considerable swelling and a livid redness of the hand ensued, with a small irregular pulse; and death occurred in about a week from the time of the accident. This, however, is not the general event of compound dislocations; and whatever may have happened in former times, we now know, that, in the present improved state of surgery, and in moderately good constitutions, these accidents mostly admit of cure. This statement may be made, without any censure being cast upon every instance of amputation performed in such cases. I know, that this operation is sometimes indispensable directly after the accident, and I am equally aware, that it may become necessary in a future stage, when extensive abscesses, or sloughing, joined with threatening constitutional symptoms, have taken place. My only design is to recommend the endeavour to cure the generality of compound luxations. But, if a case were to present itself, attended with serious contusion and laceration of the soft parts, I should be as earnest an advocate for amputation as any surgeon.

Sir Stephen Love Hammick, in speaking of compound dislocations of the ankle, advises amputation, "where the lower heads of the tibia and fibula are very much shattered; where, together with the compound dislocations of these bones, some of the tarsal bones are displaced and injured; where any large vessels are divided, and cannot be secured without extensive enlargement of the wound, and disturbance of the soft parts; where the common integuments, with the neighbouring tendons and muscles, are considerably torn; where the protruded tibia cannot by any means be reduced; and where the constitution is enfeebled at the time of the accident, and not likely to endure pain, discharge, and length of confinement." (*A. Cooper's Surgical Essays*, part ii. p. 146.) Perhaps, as general remarks, these may not be accurate; but there are exceptions to them. Thus we find in Sir A. Cooper's publication, several cases, in which compound dislocations of the ankle terminated well, notwithstanding the displacement and removal of the astragalus, other instances of which kind of success are to be found in the records of surgery. (See *Laumonier, in Fourcroy, Méd. Eclairée; Percy, in Journ. de Méd. continué* Nov. 1811. p. 348.; *Professor Stevens of New York*, see *Reese's American ed. of this Dict.*) However, if the ends of the tibia and tarsal bones, especially the astragalus and os calcis are broken, the operation of amputation is recommended on high authority. (*Sir A. Cooper's Surg. Essays*, part ii. p. 181.) But, with regard to the division of large blood-vessels, Sir A. Cooper states, that he would not at once proceed to amputation on that account. "The case from Mr. Sandford of Worcester, sent me by Mr. Carden, clearly shows, that the division of the anterior tibial artery does not, if it be well secured, prevent the patient's recovery. I also once saw a compound fracture, close to the ankle-joint, accompanied by a division of that artery; and, although the patient was in the hospital, and a brewer's servant, who possessed the worst constitution to struggle against severe injuries, yet this man recovered without amputation." Nor, in Sir A. Cooper's opinion, would all hope be precluded, even if the posterior tibial artery were injured (Vol. cit. p. 186.) For the method of securing these vessels, see Arteries.

The following are the circumstances, which Sir A. Cooper has known give rise to the necessity for amputation in compound dislocations of the ankle. 1. The advanced age of the patient. 2. A very extensive lacerated wound. 3. Difficulty of reducing the ends of the bones he considers rather as a reason for sawing them off, than for amputation. 4. The extremely shattered state of the bones. 5. Dislocations of the tibia outwards cause greater injury of the bones and soft parts, than those inwards, and more frequently require amputation. 6. Sometimes the bone cannot be kept reduced, owing to the tibia in the dislocation outwards being obliquely fractured. 7. Division of a large blood-vessel, attended with extensive wound of the soft parts. 8. Mortification. 9. Excessive contusion. 10. Extensive suppuration. 11. Necrosis, where the sequestra do not admit of removal. 12. Very great and permanent deformity of the foot. 13. When tetanus comes on, Sir A. Cooper does not approve of the operation. 14. A very irritable state of constitution, such as is often met with in very fat subjects, who take no exercise. (*On Dislocations, &c.* p. 332., &c.)

The treatment of a compound dislocation requires the reduction to be effected without delay, and with as little violence and disturbance as possible. When the extremity of the bone protrudes, and is smeared with sand or dirt, as frequently happens from its having touched the ground, "it should be washed with warm water, as the least extraneous matter admitted into the joint will produce and support a suppurative process, and the utmost care should be taken to remove every portion of it adhering to the end of the bone. If the bone be shattered, the finger is to be passed into the joint, and the detached pieces are to be removed, but this is to be done in the most gentle manner possible, so as not to occasion unnecessary irritation; and if the wound be so small as to admit the finger with difficulty, and small loose pieces of bone even be felt, the integuments should be divided with a scapel, to allow of such portions being removed without violence." (*Sir A. Cooper on Dislocations*, p. 254.) If any difficulty of reduction should arise from the bone being girt by the integuments, the opening in them should be dilated with a scapel. The limb is then to be placed in splints, with the necessary pads, eighteen-tailed bandage, &c. Sir A. Cooper judiciously recommends the portions of this bandage not to be sewed together, " but passed under the leg, so that one piece may be removed when it becomes stiff;" and by fixing another to its end, before it is withdrawn, the fresh piece may be applied, without any disturbance of the limb. (*Surg. Essays*, part ii. p. 120.) Or the limb may be laid on M'Intyre's apparatus, with which a common roller will answer even better than the eighteen-tailed bandage. The wound is to be freed from any dirt, clots of blood, or other extraneous matter, and its lips are to be accurately brought together with strips of adhesive plaster. Sir A. Cooper considers lint dipped in the blood, which oozes out, the best kind of first dressing. The joint is to be covered with linen, kept constantly wet with the liquor plumbi acetatis dilutus, or, with what is better, spirit of wine and water; the bandage is to be loosely laid down, and the splints fastened on the limb with their proper straps, or pieces of tape, and the limb is to be kept perfectly at rest in an eligible posture. The patient, if strong and young, is to be bled. An anodyne, the first night or two, will be highly proper. Saline draughts, antimonials, and a low regimen, are also indicated during the first few days of the symptomatic fever, which commonly follows.

According to Sir A. Cooper, purgatives should be used with the utmost caution; "for (says he) there cannot be a worse practice, when a limb has been placed in a good position, and adhesion is proceeding, than to disturb the processes of nature by the frequent changes of position which purges produce; and I am quite sure, that, in cases of compound fracture, I have seen patients destroyed by their frequent administration. That which is to be done by bleeding and emptying the bowels, should be effected within an hour or two after the accident, before the adhesive inflammation arises. (*Surgical Essays*, part i. p. 121.) Here the fracture bed, invented by Mr. Earle, would allow purgatives to be used, without any disturbance of the limb.

If the case take a favourable course, the constitutional fever will not be excessive, nor will the pain and inflammation of the limb be immoderate. Sometimes, the wound will unite more or less, without suppuration; a circumstance particularly desirable, as tending more than any thing else to lessen the danger, by changing the case, as it were, from a compound into a simple one. In other cases, the wound is not united; but the inflammation and suppuration are not violent, nor extensive; the constitution is not dangerously disturbed; and hopes of ultimate success may be reasonably entertained. When the wound is disposed to heal favourably, adhesive plaster, with or without lint, or a pledget of soft soap cerate, is the best dressing. In other instances, while the suppuration is copious, and the parts are tense and painful, emollient poultices are the most eligible.

When the symptomatic fever and first inflammatory symptoms are over, and much discharge prevails, attended with marks of approaching weakness, the patient is to be allowed more food, and directed to take bark, cordials, porter, wine, &c. If his nights are restless, he must have opiates; if he sweats profusely, sulphuric acid; and, in short, all such medicines, as his particular complaints may require, are to be prescribed.

When the inflammation of a compound dislocation is violent or extensive, general bleeding, the application of leeches, and the use of fomentations, and poultices, are the most likely means of lessening the mischief. Yet, it is only in strong habits, that venesection to any extent can be prudently practised in large cities, or crowded hospitals.

The following are the instructions delivered by Sir A. Cooper, on the subject of dressings:—"If the patient complain of considerable pain in the part, in four or five days, the bandage may be raised, to examine the wound; and, if there be much inflammation, a corner of the lint (or other dressing) should be lifted from the wound, to give vent to any matter which may have formed; but this ought to be done with great circumspection, as there is danger of disturbing the adhesive process, if that be proceeding without suppuration. By this local treatment, it will every now and then happen, that the wound will be closed by adhesion; but, if in a few days it be not, and suppuration take place, the matter should have an opportunity of escaping; and the lint being removed, simple dressings should be applied. After a week or ten days, if there be suppuration with much surrounding inflammation, poultices should be applied upon the wound, leeches in its neighbourhood, and upon the limb at a distance, the evaporating lotion should still be employed; but, as soon as the inflammation is lessened, the poultices should be discontinued." (*Surgical Essays*, part ii. p. 121.)

In certain examples, the most skilful treatment is unavailing. The joint and limb become affected with considerable pain and swelling; the fever runs high; delirium comes on; and the patient may even perish from the violence of the first symptoms, the limb being generally at the same time attacked by gangrene. If these first dangers are avoided, the wound may yet not heal favourably; the inflammation may be considerable, or of an erysipelatous nature; large abscesses under the fascia may be formed; the bones may be affected with necrosis; and the hectical symptoms and sinking state of the patient, may make the only chance of recovery depend upon amputation. But, even this operation is sometimes deferred till too late, and the patient must be left to his fate.

Whoever gives the smallest reflection to the nature of compound luxations, will perceive, that it is often a matter of the highest importance to make a right decision at the very beginning, whether amputation should be immediately done, or an attempt made to save the limb. In some instances, the patient's sole chance depends upon the operation being performed at once, without the least delay, and the opportunity of doing it never returns. The surgeon should take off the limb as soon as he has seen the nature of the injury, and not wait till a general tendency to swelling and gangrene has spread through the member, and every action in the system is disturbed. Amputation, under these circumstances, is sometimes unadvisable, the system not being in a condition to bear it, and the patient likely to die on the operating table; and every surgeon knows, that when the operation is performed for a spreading gangrene, it is always performed with a very diminished chance of success. Indeed, until certain facts were adduced by Baron Larrey, Mr. Lawrence, Mr. A. C. Hutchison, and others, it was not long ago altogether prohibited. (See AMPUTATION and MORTIFICATION.

But, besides this first critical period, the surgeon often has to exercise a nice degree of judgment in a future stage of the case; I mean when the suppuration is copious, the wound open, the bones affected with necrosis, and the health impaired. Here the practitioner may sometimes err, in taking off a limb that might be saved; or, he may commit a worse fault, and make the patient lose his life in a fruitless attempt to save the member. No precepts can form the right practitioner in this delicate part of surgery; genius alone cannot do it; the opportunity of making observations, and the talent of profiting by them, are here the things which make the consummate surgeon.

It should ever be recollected, in regard to bad compound dislocations, that in young subjects, and in a salubrious air, many cases will do well, which, in old persons, and in the polluted atmosphere of London, and crowded hospitals, would be fatal without amputation.

The constitutions of some individuals are so irritable, that whether an attempt be made to save the limb, or amputation be at once performed, the case has a rapid and fatal termination. According to Sir A. Cooper, persons who are much loaded with fat "are generally irritable, and bear important accidents very ill: indeed," says he, "they generally die, whichever plan of treatment be pursued." However, he adds, that such corpulent people as take a great deal of exercise, form exceptions to the foregoing remark. (*Surgical Essays*, part ii. p. 195.)

There is a practice in regard to compound dislocations, which I think ought at all events to be adopted only in a few cases: I mean the plan of sawing off the head of the luxated bone. According to Leveillé, this method is recommended by Hippocrates, as a means of accelerating and perfecting the cure. (*Nouvelle Doctrine Chirurgicale*, t. ii. p. 44.) However, it seems not to have done sufficient good in ancient times, to have obtained a lasting reputation. In fact, when it was mentioned by the late Mr. Gooch, it had sunk into such oblivion, that it was received as an entirely new proposal. "Compound luxations (says this author,) are of a more dangerous nature than compound fractures, for very plain reasons; but, if a surgeon should judge it advisable to attempt saving a limb under such threatening circumstances, *I am inclined to think, from what I have observed, he will be more likely to succeed by sawing off the head of the bone, especially if it has long been quite out, and exposed to the air.*"

Mr. Gooch afterwards takes notice of a case in which Mr. Cooper, of Bungay, sawed off the heads of the tibia and fibula, and preserved the limb, the patient being able to walk and work for his bread for many years afterwards. Other examples are also briefly mentioned, in which the lower head of the radius was sawn off, and the head of the second bone of the thumb.

The late Mr. Hey, of Leeds, was induced to make trial of this plan in a compound luxation of the ankle. The example, however, which he published, is decidedly unfavourable to the practice, as the following passage will show: — "I was in hopes that this patient would have been able to walk stoutly, but, in this I was disappointed. He walked indeed without a crutch; but his gait was slow, his leg remaining weak, and his toes turning outwards, which rather surprised me, as his leg was very straight, when I ceased attending him.

Mr. Hey did not recite this case with the view of recommending a similar practice in all cases of this accident; for he had not always adopted it, nor was he of opinion, that the same mode of treatment, whether by replacing the bones, sawing off their extremities, or amputating the limb, ought to be universally practised. When the laceration of the capsular ligament and integuments is not greater than is sufficient to permit the head of the tibia to pass through them; and, when, at the same time, the joint, or contiguous parts have suffered no other injury; Mr. Hey recommends the replacing of the bone, and a union of the integuments by suture, with the treatment adapted to wounds of the joints. (*Practical Obs. in Surgery*, chap. xi. ed. 2.)

That in a few cases recorded by Gooch, and Hey, the patients recovered with a new sort of joint, only proves to my mind the great resources and activity of nature, and her occasional triumph over the opposition she meets with from injudicious surgery. A limb so treated must ever afterwards be shorter than its fellow, and consequently the patient be more or less a cripple. We have seen that, in the only instance published by Mr. Hey, considerable deformity was the consequence of the practice. I cannot help adding my belief, that this gentleman would have experienced more success in the treatment of compound dislocations, had he relinquished the objectionable method of sewing up the wound. In such accidents, every kind of irritation should be avoided as much as possible, and that the wound may be conveniently closed with sticking plaster, the observation of numerous cases has perfectly convinced me.

The most ingenious arguments, which have yet been urged in behalf of the practice of sawing off the ends of the bones, in compound dislocations of the ankle, are those recently published by Sir A. Cooper. However, he does not advise the plan without restrictions. If the dislocation (says he) can be easily reduced, without sawing off the end of the bone; if it be not too obliquely broken to remain firmly upon the astragalus after being reduced; if the end of the bone be not shattered, for then the small loose pieces of bone should be removed, and the surface of the bone be smoothed by the saw: if the patient be not excessively irritable, and the muscles affected with violent spasms, impeding reduction, and causing a displacement of the bones after they have been reduced; Sir Astley Cooper advises the immediate reduction of the parts, and uniting the wound by adhesion. In the opposite circumstances, rather than amputate the limb, he would saw off the ends of the bones. (*Surgical Essays*, part i. p. 154.; and *Treatises*, p. 302.)

M. Roux gives much praise to the English surgeons for the judicious boldness which they have evinced in cases of this description. Although Fabricius Hildanus, Ferrand, Desault, Laumonier, and several other French surgeons, have, like many British practitioners, ventured to remove the whole of the astragalus, when this bone was totally separated from the scaphoides, and protruded in compound luxations; yet M. Roux acknowledges, that the bold practice of sawing off the lower end of the humerus, the lower end of the radius, the lower end of the tibia, and also of the fibula at the same time, originated with, and was first executed by, English surgeons. (*Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise*, pp. 208, 209.)

Dislocations of the lower Jaw.

The lower jaw can only be luxated forward, and either one or both of its condyles may become displaced in this direction. Every dislocation, except that forward, is rendered impossible by the formation of the parts. The lower jaw cannot even be dislocated forward, unless the mouth, just before the occurrence of the accident, be very much open. Whenever the chin is considerably depressed, the condyles slide from behind forward, under the transverse root of the zygomatic processes. The cartilaginous cap which envelopes the condyles, and follows them in all their motions, still affords them an articular cavity; but, the depression of the bone continuing, the ligaments give way, the condyles glide before the *eminentiæ articulares*, and slip under the zygomatic arches. Hence a dislocation mostly happens, while the patient is laughing, gaping, &c. A blow on the jaw, a spasm, or any irregular action of the muscles, when the mouth is wide open, may easily cause the accident. The case has occasionally arisen from the exercise of great force in drawing out the teeth. Sir Astley Cooper has known a complete luxation, that is to say, of both condyles, produced by a boy suddenly putting an apple into his mouth, to keep it from the reach of a playfellow. (*On Dislocations*, p. 389.) Whenever the jaw has once been dislocated, the same causes more easily reproduce the occurrence. In certain individuals, the ligaments are so loose, that a dislocation is produced by any slight attempt to yawn, laugh, or (as Lamotte has observed) to bite any substance which is rather large. (*Leveillé, Nouvelle Doctrine Chir.* t. ii. p. 54.) There have been persons, who could scarcely ever laugh heartily, without their lower jaws being luxated. But, of all the causes of this occurrence, yawning alone, even without the combination of any external force, is by far the most common.

When the jaw is depressed, if the muscles contract, the anterior fibres of the masseter tend to bring the condyles under the zygoma. The external pterygoid muscle will also contribute to produce the same effect.

Dislocations of the lower jaw are attended with a great deal of pain, which Boyer imputes to the pressure produced by the condyles on the deep-seated temporal nerves, and those going to the masseters, which nerves pass before the roots of the zygomatic process. The mouth is wide open, and cannot be shut. It is more open in recent dislocations, than in those which have continued for some time. An empty space is felt before the ear, in the natural situation of the condyles. The coronoid process forms under the cheek-bone a prominence, which may be felt through the cheek or from within the mouth. The cheeks and temples are flattened by the lengthening of the temporal, masseter, and buccinator muscles. The saliva flows in large quantities from the mouth, the secretion of which fluid is greatly increased by the irritation of the parotid gland. The arch, formed by the teeth of the lower jaw, is situated more forward than that formed by the teeth of the upper jaw. During the first five days after the accident, the patient cannot speak, and, according to Boyer, he cannot swallow. When only one condyle is dislocated, the mouth is distorted, and turned towards the opposite side, while the fellow-teeth of the jaws do not correspond. However, Mr. Hey asserts, that frequently the position of the chin is not perceptibly altered. (*Practical Obs.* p. 322.) The mouth cannot be shut; but, it is not so widely open as in the complete luxation. (*Sir A. Cooper on Dislocations*, p. 392.)

When a dislocated jaw has remained unreduced for several days or weeks, the symptoms are not so well marked. In such instances, the chin becomes gradually approximated to the upper jaw; the patient recovers by degrees the faculty of speaking and swallowing; but he stammers, and the saliva dribbles from his mouth. The sufferings induced by a dislocated jaw, it is said, may even prove fatal, if the case continue unrectified; but, we are not to believe Hippocrates when he positively declares the accident mortal, if not reduced before the tenth day. Indeed, Sir Astley Cooper, in noticing the severity of the pain, assures us that he has never seen any dangerous effect produced; on the contrary, that in time, the jaw becomes more closed, and a considerable degree of its motion is restored. (*On Dislocations*, p. 389.)

Monteggia attended a man two months after such a luxation, which had not been understood; and Fabricius ab Aquapendente assures us, that he had never seen the prognostic of Hippocrates verified, though he had had many patients of this sort under his care. (*Leveillé, Nouvelle Doctrine Chir.* t. ii. p. 58.)

Dislocations of the lower jaw may be reduced in the following manner: — The surgeon is first to wrap some linen round his thumbs, to keep them from being hurt by the patient's teeth, and then introduce them into the mouth, as far as possible along the grinding teeth. At the same time, he is to place his fingers under the chin and base of the jaw; and while he depresses the molares with his thumbs, he raises the chin with his fingers, by which means the condyles become disengaged from their situation under the zygomas; at which instant the muscles draw the condyles so rapidly back into the articular cavities again, that the surgeon's thumbs might sometimes be hurt, did he not immediately move them outward between the cheek and the jaw.

The reduction having been accomplished, a fresh displacement is to be prevented by applying a four-tailed bandage, as recommended for the fractured jaw. For a few days, the patient should avoid all food requiring much mastication.

The ancients used to place between the grinding teeth two pieces of stick; and while they used them as levers to depress the back part of the bone, they raised the chin by means of a bandage. The late Mr. Fox, the dentist, had a patient, whose jaw had been dislocated on both sides, in the extraction of a tooth: the reduction was first effected on one side, by placing a piece of wood, a foot long, upon the grinders, and then raising the part of it that was held in the hand. Mr. Fox next reduced the other condyle in the same manner. Sir Astley Cooper, in reducing a complete luxation of the lower jaw, prefers putting the patient in the recumbent posture, introducing two corks behind the molar teeth, and then elevating the chin. (*On Dislocations*, p. 391.) When only one condyle is dislocated, whatever method of reduction be followed, it need only be applied to the side affected.

Dislocations of the Vertebræ.

What have been called dislocations of the spine, are considered by Sir Astley Cooper as really fractures of the vertebræ, with displacement of the bones, but not of the intervertebral substance. The only true dislocations of the spine admitted by him, are those of the first and second cervical vertebræ. (*On Dislocations, &c.* p. 17.)

The large surfaces with which the vertebræ support each other; the number and thickness of their ligaments; the strength of their muscles; the little degree of motion which each vertebra naturally has; and the vertical or slightly oblique direction of the articular processes, are generally supposed to make dislocations of the dorsal and lumbar vertebræ impossible, unless there be also a fracture of the above-mentioned processes. Thus, Sir Astley Cooper, in his very extensive experience, has never witnessed a separation of one vertebra from another through the intervertebral substance, without fracture of the articular processes; or, if those processes remained unbroken, without a fracture through the bodies of the vertebræ. In three cases, recorded by Dupuytren, the intervertebral substance was lacerated, and the bodies of the vertebræ were uninjured; but, in two of them, the spinous, transverse, and articular processes were broken off; while, in the third, all these parts were not hurt. (*Clin. Chir.* t. i. p. 395.) These cases can only result from immense violence. The symptoms would be an irregularity in the disposition of the spinous processes, retention or incontinence of the urine and feces, paralysis and a motionless state of the lower extremities, and other circumstances which will be presently enumerated, noticed by Dupuytren in one remarkable case, the effects of the pressure or other injury to which the spinal marrow would be subjected. Similar symptoms may also arise when the spinal marrow has merely undergone a violent concussion, without any fracture or dislocation whatever; and it is certain, that most of the cases, mentioned by authors as dislocations of the lumbar and dorsal vertebræ, have only been concussions of the spinal marrow, or displacement with fracture.

The cervical vertebræ, however, having less extensive articular surfaces and a greater degree of motion, are occasionally luxated. The dislocation of the first vertebra from the second, is the most common; but luxations of the cervical vertebræ lower down, though rare, are possible. Indeed, according to Boyer, many examples have happened, in which one of the inferior oblique or articular processes of a cervical vertebra, as been dislocated, so as to cause a permanent inclination of the neck towards the side opposite to that of the displacement. (*Mal. Chir.* t. iv. p. 114.)

Whether the case published by Sir C. Bell, under the name of a subluxation of the spine, ought to be received as an unequivocal specimen of a displacement of the last cervical from the first dorsal vertebra, I cannot presume to determine. This author speaks of an evident loosening between these two bones; of a considerable space between them; of the destruction of the intervertebral substance; and of an immense quantity of pus around the injured part of the spine; as circumstances seen in the dissection. "On the back part, the pus had extended under the scapulæ, and on the fore part was bounded by the œsophagus," and, in the spinal canal, it had descended through the whole length of the sheath to the cauda equina. (*Sir C. Bell, Surg. Obs.* vol. i. p. 148.)

Rust declares, however, that even the lumbar and dorsal vertebræ may be dislocated. (*Arthrokakologie*, p. 71.) Sir C. Bell also describes a case of complete dislocation of the last dorsal from the first lumbar vertebra, with entire division of the spinal chord. A small portion of bone was broken off. (*On Injuries of the Spine and Thigh-bone*, p. 25. pl. 2. fig. 2. and 3.) We learn from Mr. Lawrence, that the museum of St. Bartholomew's Hospital contains specimens of luxated cervical vertebræ. In one of these, the right inferior articular process of the fifth vertebra is dislocated forwards. The portion of the vertebral column, above the seat of the injury, is twisted to the left, and the body of the fifth having been partially displaced, projects beyond that of the sixth vertebra. This displacement could not have been effected without considerable injury of the fibro-cartilage. The upper and anterior part of the body of the sixth and seventh vertebræ has been slightly fractured on the left side. In another case, the inferior articular processes of the fifth cervical vertebra are partially separated from those of the sixth. The bodies of the same bones are partially separated behind. A third specimen exhibits a dislocation of the sixth from the seventh cervical vertebra. The inferior articular processes of the sixth are completely dislocated forwards, and its body projects over that of the seventh. Mr. Lawrence has recorded one case, proving that complete dislocation both of the articular processes and body, without fracture, may occur in the cervical region of the spine. (See *Med. Chir. Trans.* vol. xiii. p. 391—394.) A gentleman, attending my lectures, three or four years ago, lent me a specimen of a complete dislocation of the middle cervical vertebræ without fracture. The preparation was shown by me to the surgical students at University College. The accident befel a person, who was sitting upon an omnibus as it passed rapidly under a gateway, the upper part of which struck against him with immense violence. Baron Dupuytren has also recorded an instance of a dislocation of the sixth from the seventh cervical vertebræ, without any previous fracture. The patient, a woman fifty-six years old, lived thirty-four hours after the accident. There was total loss of sensibility in the lower extremities, and the rectum, bladder, parietes of the abdomen, and all parts below the diaphragm, seemed, as it were, dead. Above this point, the upper extremities were also in a state of incomplete paralysis, with respect both to motion and feeling. Respiration was frequent and laborious; but the speech, senses, motions of the countenance, and intellectual faculties, were not affected, and seemed to belong to another individual. The pulse was full and soft; the tongue dry and brownish; and the skin natural in point of temperature and exhalation. (See *Dupuytren, Clin. Chir.* t. i. p. 390.)

DISLOCATION OF THE HEAD FROM THE FIRST VERTEBRA, OR ATLAS.

The os occipitis and first cervical vertebra are so firmly connected by ligaments, that there is no instance of their being immediately luxated from an external cause; and, were the accident to happen, it would prove fatal, by the unavoidable compression and injury of the spinal chord.

Five examples of displacement of the atlas by disease are in the museum at Leyden, and are described by Sandifort. Boyer has seen one at La Charité; and an interesting description of a similar case, illustrated by engravings, has been recently published by Schupke. (*De Luxatione Spontanea Atlantis et Epistrophei*, 4to. Berol. 1816.) In this tract is collected, from the writings of J. P. Frank (*Delect. Opusc.* vol. v.), from those of Reil (*Fieberlehre*, b. ii. § 102.), and of Rust, &c. an exact detail of the symptoms of the disease; an important topic, on which Boyer confesses his inability to give any information. The symptoms have been described by Mr. Lawrence as follows:—"Pain in the neck, becoming more severe at night, or in swallowing a large mouthful, or drawing a deep breath, is the first symptom. This pain affects one side of the neck, especially when the head is moved towards the shoulder; it extends from the larynx towards the nape, and often to the scapula of the pained side. No external alteration is perceptible; but firm pressure on the region of the first and second vertebræ produces considerable pain, and thus points out the seat of disease. The difficulty of swallowing and breathing, and hoarseness, increase, alternating with pain in the neck, which seems to fix about the back of the head, and becomes intolerable on moving that part. The head sinks towards one shoulder, the face being turned a little down; for, in general, the articulations are affected on one side only, and that was the left in seven out of nine examinations after death. If both sides are affected, the head will incline directly forwards. In this state things continue for several weeks or months; and before worse symptoms come on, there is often apparent improvement, freer motion, and more natural situation of the head. But, the uneasiness in speaking and swallowing returns; the pain becomes more severe and extensive; the head falls a little backwards, and shrinks towards the opposite side. The patient feels as if the head were too heavy, and he carefully supports it with his hands, when he moves from the sitting to the lying position, or *vice versâ*. This may be considered a pathognomonic symptom of the affection. Another symptom, which, at this period, shows the true nature of the disease, is a peculiar expression of pain in the countenance, which, combined with the position and stiffness of the head, constitutes so characteristic an assemblage of appearances, that it is enough to have seen it once, in order to recognise it again immediately. In the further progress of the case, noise in the head, deafness, giddiness, cramps, and convulsions, partial paralysis, particularly of the upper limbs, loss of voice, purulent expectorations, and hectic symptoms supervene. Generally no external change is observable, either in the neck, or in the nape; and Rust observed, in one case only, swelling of the affected side, which broke and left fistulous ulcers. But, the slightest pressure in the region of the three upper vertebræ is acutely painful, and sometimes, in the advanced period of the disease, a grating of rough surfaces is distinctly perceptible when the head is turned. The patient may continue for months in this helpless and painful state, and then dies, either from exhaustion and debility, or, which is more frequent, suddenly and unexpectedly." (*Lawrence*, in *Med. Chir. Trans.* vol. xiii. p. 406.) These spontaneous displacements of the atlas may depend upon caries and scrofulous disease of its articular surfaces, or upon an exostosis of its transverse process, or a similar tumour growing from the neighbouring portion of the os occipitis, or petrous portion of the temporal bone. By these causes, the anterior, or posterior arch, or one of the sides of the atlas, has been made to intercept a third, the half, and even two-thirds, of the diameter of the foramen magnum. Notwithstanding these changes, life may be carried on, and the nutritive functions performed sufficiently well to afford time enough either for the exostoses to attain a large size, or for the anchylosis, binding together the head and most of the cervical vertebræ, to acquire great solidity. The size of the foramen magnum, and the dimensions of the vertebral canal in the neck, are considerably beyond what would be necessary for simply containing the spinal marrow, so that the free lateral movements of the head and atlas can be executed without any risk of pressure on that important part. Hence spontaneous displacement can occur in these cases to a considerable degree, without impairing the functions of the spinal chord. (*Lawrence*, in *Med. Chir. Trans.* vol. xiii. p. 411.) According to Boyer, the atlas is never found free and distinct, when thus displaced; but is confounded at least with the os occipitis, and mostly with five or six of the subjacent vertebræ. And, another interesting fact is, that, in cases of this description, the joint between the atlas and occiput is never the only one, which is displaced and deformed, unless the disease be very slightly advanced; for, the articulation of the processus dentatus with the atlas, and sometimes that of the point of the same process with the occiput, are considerably affected. Sometimes the processus dentatus and the occiput retain their natural position with respect to each other, and the atlas alone seems to be displaced between them. Sometimes the second vertebra is out of its place with respect to the os occipitis, in the same direction as the atlas, but not in quite so great a degree. Lastly, in some other instances, the two vertebræ are twisted in opposite directions; as, for instance, one to the left, the other to the right; or *vice versâ*. In one of the cases, recorded by Sandifort, this kind of lateral displacement in opposite directions was so extensive, that an interspace, only six lines in breadth, was left between their approximated annular margins. An instance was seen by Duverney, where the displacement of the two vertebræ was from before backward, and where the processus dentatus was approximated to the posterior arch of the atlas to the extent of two-thirds of the annular opening in this vertebra. In these cases, nothing can be more obvious, than that there must be a destruction, or, at all events, a thoroughly diseased state of the ligaments between the atlas and dentatus, and of those connecting the dental process to the occiput. (*Boyer*, vol. cit. p. 105.)

As for the treatment of the preceding forms of disease, experience has hitherto furnished little satisfactory knowledge. But, as an analogy is seen between these cases and the scrofulous and carious affections of other joints, blisters, setons, and issues, have been proposed and tried. Rust found these remedies only capable of retarding the progress of the disease, and of producing an abatement of the symptoms. The pain often reaching from the back of the head to the forehead, was rendered less severe; and the difficulty of swallowing was considerably lessened. But the means here specified were not found adequate to arrest the morbid change in the bones. However, Rust thinks that greater benefit might be expected, if a case were to present itself arising altogether from a local cause, without its origin being connected with constitutional disease.— (*Salzburger Med. Chir. Zeitung, jahrgang.* 1813. b. iii. p. 108.) In a later work, he adverts to some examples, in which a cure was effected by nature. Indeed, the occasional termination of the disease by anchylosis is a full proof of this fact. (*Arthrokakologie*, § 118.)

Dislocations of the First Cervical Vertebra from the Second.

The rotatory motion of the head is chiefly performed by the first vertebra moving on the second. When this motion is forced beyond its proper limits, the ligaments which tie the processus dentatus to the edge of the foramen magnum are torn; and, supposing the head to be forced from the left to the right, the left side of the body of the vertebra is carried before its corresponding articulating surface, while the right side falls behind its corresponding surface. Sometimes the processus dentatus, whose ligaments are ruptured, quits the foramen formed for it by the transverse ligament and the anterier arch of the first vertebra, and presses on the medulla oblongata. But, according to Boyer, the processus dentatus may be displaced in two ways: 1st, It may be carried directly backwards, the transverse and other ligaments being broken. This mode of displacement Boyer considers as the most difficult and uncommon, as it can hardly take place, except from a fall from a great height upon the back of the head, while the spine is bent forwards. (*Traité des Mal. Chir.* t. iv. p. 109.) However, the accident may happen in another manner, as in Sir C. Bell's instance, where it occurred from the chin striking against a curb-stone. (*Surg. Obs.* vol. i. p. 150.) 2dly, In a violent rotation, in which the face is carried sideways beyond the proper limits, the lateral and accessory ligaments of the processus dentatus may be stretched and twisted spirally round this process. The force operates entirely upon them, and not at all upon the tranverse ligament. Now when the lateral and accessory ligaments of the processus dentatus have given way, and an effort to incline the head to one side is kept up, one of the sides of the space, bounded by the transverse ligament, may present itself near the point of the processus dentatus, which may then pass below the transverse ligament without rupturing it.

In children, where the processus dentatus is not fully developed, and the ligaments are weaker than in the adult, a perpendicular impulse may break the lateral and accessory ligaments, and then force the processus dentatus under the transverse ligament, without rupturing this latter part; as Boyer conceives must have been the case in the child, which J. L. Petit mentions as having been instantaneously killed by being lifted up by the head.

Lastly, when the transverse, lateral, and other ligaments are capable of making very great resistance to a force, tending to rupture them all, and to throw the processus dentatus directly backwards, this process, if more slender than common, may be broken near its base, and this portion of it forced back upon the spinal marrow. A case, exemplifying the occurrence, used to be related by Mr. Else in his lectures, and is recorded by Sir Astley Cooper. (*On Dislocations*, p. 348.; *Boyer*, vol. cit. p. 110.)

Patients can hardly be expected to survive mischief of this kind in so high a situation: when the transverse ligament is broken, and the processus dentatus is thrown directly backward against the medulla oblongata, the effect must be instant death, as happened in the case recorded by Sir C. Bell (*Surg. Obs.* vol. i. p. 150.), and in that mentioned by Mr. Else.

The causes of this formidable accident are various: a fall on the head from a high place; the fall of a heavy body against the back of the neck; a violent blow; a forcible twist of the neck; tumbling; standing upon the head; the rash custom of lifting children up by the head, &c. Louis believed, that the first vertebra was dislocated from the second in the malefactors hanged at Lyons, at which place the executioner used *to give a sudden twist* to the body at the moment of its suspension, and then bear with all his weight upon it. Under such circumstances, Boyer conceives, that the processus dentatus might pass under the transverse ligament, without any rupture of the latter.

Perhaps, the only recorded instances of luxation of the processus dentatus, independently of external violence, or previous disease, are two; one noticed by Mr. Cruikshank (See *Lond. Med. Gaz.* vol. iii.); the other by Dr. Wm. Thompson (*Edin. Med. and Surgical Journ.* vol. xlii. p. 279.).

When dislocations of the cervical vertebræ occur at the third, fourth, fifth, or sixth of these bones, and only one articular process is luxated, the accident is not always fatal. In these instances, the vertebral canal is not so much lessened as to compress the spinal marrow, and occasion immediate death.[1]

With regard to the prognosis of all luxations in which the processus dentatus is displaced suddenly and not gradually by disease, I may observe, that such cases are mostly fatal. Mistaken notions have been entertained upon this point, in consequence of particular dislocations of the neck having been successfully treated.

A child was brought to Desault, with its neck bent, and its chin turned towards the right shoulder. The accident had been a consequence of the head having being fixed on the ground, while the feet were up in the air. A surgeon happened to be with Desault at the time, and they agreed to make an attempt to reduce the luxation, and to apprise the mother, that though the child might be cured, there was a possibility of its perishing under their hands. Being permitted to do what they judged proper, they fixed the shoulders, and the head was gently raised, and gradually turned into its natural position. The child could now move freely; the pain ceased; and a considerable swelling in the situation of the luxation, yet left, was dispersed by the application of emollient poultices. (*Leveillé Nouvelle Doctrine Chir.* t. ii. p. 62.)

Another alleged instance of the reduction of a dislocation of the neck is recorded. (*Schmucker's Vermischte Chir. Schriften*, b. i.) However, both in this case, and that related by Desault, there can be no doubt, that the accident was not a dislocation of the dentata from the atlas, but a luxation of one of the oblique processes of a cervical vertebra lower down. Whenever the processus dentatus is suddenly displaced or fractured, the effects on the medulla spinalis, one would expect, must be inevitably fatal. A case, indeed, was attended by Mr. Cline, in which the processus dentatus had lost a part of its natural support, in consequence of a transverse fracture of the first vertebra, and in which the child survived the accident a year. (See *Sir A. Cooper on Dislocations*, p. 549.)

My friend, Mr. Benjamin Phillips, has favoured me with the following very remarkable case, a more particular account of which has been inserted in the Transactions of the Royal Med. Chir. Society of London, vol. xx.: —

"Wm. Cross fell from a hayrick to the ground, the occiput first coming in contact with the soil; he was stunned by the accident; but, in a few minutes, was able to walk to the residence of the parish surgeon, by whom he was bled and purged. In two or three days he was enabled to resume his usual avocations.

"The only inconvenience which succeeded to the accident, was inability to rotate the head; and for this symptom, three weeks after the accident, I saw him.

"He complained of a slight tenderness over the superior cervical region, which was a little painful upon pressure, and presented a very inconsiderable tumefaction.

"The conclusion come to was, that either chronic inflammation or caries affected the atloido-axal articulation. Under this impression, leeches were applied every two days for three weeks, without any other benefit than a lessening of the tenderness. By means of caustic potash, an issue was maintained over the point for nearly four months; but rotation of the head was still impracticable.

"After the drying up of the issues, or in about six months from the receipt of the injury, he had an attack of pleurisy, for which it was necessary to resort to very active depletion.

"When he had become convalescent from the pleurisy, symptoms of anasarca were manifested, under which he ultimately sunk, eleven months after the receipt of the injury.

"Sensation and motion, with the exception I have named, were in no degree impaired, and about this there could be no fallacy; for, he was accustomed to feed himself while lying on his back, and to walk to the water-closet daily. During the last three months of his life, he had complained of some difficulty in swallowing, and his voice was observed to be rather thick; but, upon looking into the throat, there was no obvious cause for these symptoms.

"After death the cervical region was examined and, at first sight, no very particular lesion was evident; but, upon more careful examination, it was found that a complete transverse fracture of the atlas had occurred. The anterior moiety of the ring, including the joints of articulation with the occiput, had been carried downwards and forwards in front of the axis, had arrived on the same plane with it, and had become connected to it by perfect bony union. The strength of the transverse ligament, which embraces the neck of the processus dentatus, had been sufficient to retain that organ in its grasp, and, consequently, the latter had been fractured and carried down with it; and to this circumstance the patient, no doubt, owed his life; for had the ligament given way, the process would inevitably have lacerated the spinal cord.

"The morbid specimen is in the possession of Sir C. Bell. The importance of this unique case arises from its invalidating the principle, so confidently laid down, that such an injury in this region must necessarily be fatal."

T. E. Schmidt, De Luxatione Nuchæ. *Haller*, Disp. Chir. t. ii. p. 351. Tub. 1747. *S. T. Soemmering*, Bemerkungen über Verrenkung und Bruch des Rückgrats, 8vo. Berlin, 1793. *Boyer*, Traité des Mal. Chir. t. iv. p. 100. &c. 8vo. Paris, 1814. *A. E. Schupke*, De Luxatione Spontanea Atlantis et Epistrophei, 4to. Berol. 1816. Sir *C. Bell*, Surgical Obs. vol. i. p. 145. 149, &c. 8vo. Lond. 1816. Obs. on Injuries of the Spine, &c. 4to. 8vo. Lond. 1824. Sir *A. Cooper*, on Dislocations, &c. p. 548—551, &c. 4to. Lond. 1822. *Lawrence*, in Med. Chir. Trans. vol. 13. *Dupuytren*, in Clin. Chir. t. i. art. 15. *Wm. Thomson*, M. D. in Ed. Med. Surg. Journ. vol. xlii. *Benjamin Phillips*, in Med. Chir. Trans. vol. xx. p. 78.

Dislocations of the Clavicle.

Are much less common than fractures, which are said to occur six times more frequently. In fact, the clavicle is so strongly articulated both with the sternum and scapula, that its dislocations are rare in comparison with those of many other joints.

The clavicle may be luxated at its sternal extremity, forwards, backwards, and upwards; but never downwards, on account of the situation of the cartilage of the first rib. The luxation forwards is the most frequent; dislocations backwards and upwards are unusual; and one directly backwards is still more rare. This last case Sir Astley Cooper has never known arise from violence; but, he conceives, that it might happen from a blow on the fore part of the bone, rupturing the capsular ligament and that between the clavicle and rib. The only instance of the dislocation backwards, with which this experienced surgeon is acquainted, proceeded from great deformity of the spine. In this extraordinary case, the bone gradually slipt behind the sternum, and produced so much inconvenience, by its pressure on the œsophagus, that the late Mr. Davie, of Bungay, in Suffolk, was obliged to remove its sternal extremity. (*Sir A. Cooper on Dislocations*, p. 395. 401.)

If the dislocation be forwards, a hard circumscribed tumour is felt, or even seen, on the front and upper part of the sternum. According to Boyer, when the shoulder is carried forward and outward, the tumour disappears; but, in Sir Astley Cooper's account, it is said, that the projection on the sternum will subside, if the shoulder be drawn backward. The shoulder being elevated, the projection descends; if it be drawn downwards, the dislocated extremity of the bone becomes elevated to the neck. The motions of the clavicle are painful, and the patient moves the shoulder with difficulty. The point of the acromion is less distant from the central line of the sternum than usual. The dislocation forwards is sometimes incomplete, only the front of the capsular ligament being torn. The dislocation forwards is generally produced by a fall upon the point of the shoulder, when the force pushes the clavicle inwards and forwards; but, it also frequently happens, from falls upon the elbow when this is separated from the side, and thus the clavicle is propelled violently inwards and forwards against the anterior portion of the capsular ligament. (*Sir A. Cooper on Dislocations*, p. 399.

When the luxation is upwards, the distance between the sternal ends of the clavicles is diminished.

When the dislocation is backwards, there is a depression where the end of the clavicle ought to be, and the head of the bone forms a projection at the front and lower part of the neck, which, as J. L. Petit remarks, may compress the trachea, œsophagus, jugular vein, carotid artery and nerves. The head is inclined towards the side, on which the accident itself is situated.

In reducing dislocations of the sternal end of the clavicle, we are to make a lever of the arm, by means of which the shoulder is brought outwards; and when thus brought outwards, it is to be pushed forwards, if the dislocation be in that direction; backwards, if the dislocation be behind; and upwards, if the dislocation be above.

The same position of the arm, and the same apparatus, as in fractures of the clavicle, are to be employed. The wedge-like pad, with its thick part towards the axilla, for the purpose of inclining the shoulder outward, a sling for the support of the weight of the arm, and a bandage judiciously applied, are especially necessary. In consequence of the obliquity and smoothness of the articular surfaces, the reduction is easy, but great attention is requisite to prevent a return of the displacement.

Dislocation of the scapular end of the clavicle from the acromion upwards is the only case. The rarity of a dislocation of the scapular end is owing to the strength of the ligaments tying the clavicle and acromion together. However, while Desault and Boyer represent the case as much less common than displacements of the sternal end of the bone, Sir Astley Cooper's experience pronounces them to be more frequent. (*On Dislocations*, p. 405.) I have seen not less than four or five dislocations of this kind. The last was in a man under Mr. Langridge, of Staines.

A fall on the top of the shoulder may cause the dislocation upwards. The scapular end of the clavicle then slides upwards on the acromion, and the shoulder is drawn inwards by the muscles which approximate the arm to the body. It has been asserted, that the violent action of the trapezius muscle, in pulling the clavicle upwards, may tend to produce the accident; but, as Sir Astley Cooper has remarked, the mere action of this muscle, without the simultaneous operation of great violence, could never tear both the ligaments of the coracoid process, which must be broken ere this dislocation can happen. When the projection is but slight, as Sir A. Cooper has sometimes noticed, the circumstance indicates that the internal ligament is not ruptured. (*On Dislocations*, p. 406.) Pain at the top of the shoulder, a projection of the end of the clavicle under the skin covering the acromion, and a depression of the shoulder, are symptoms indicating what has happened. The patient also inclines his head to the affected side, and avoids moving his arm or shoulder.

This dislocation is reduced by carrying the shoulder outwards, putting a thick cushion in the axilla, and applying Desault's bandage for fractures of the clavicle (see Fractures), making the turns ascend from the elbow to the shoulder, so as to press the luxated end of the bone downward, and keep it in its due situation, at the same time that the elbow is confined close to the side, and supported in a sling, by which means the shoulder will be kept raised and inclined outwards. This plan, which is advised by Boyer, is more efficient than the common practice, which consists in applying a compress, the figure of 8 bandage, and supporting the arm in a sling. However, the exact maintenance of the reduction, by any apparatus whatever, is found to be a matter of the greatest difficulty, and some slight deformity will remain, though it is agreeable to know that, notwithstanding this disadvantage, the use of the limb returns very well. I have seen cases in proof of the truth of this statement, and one example was shown me by my friend Mr. Vincent, in St. Bartholomew's Hospital. The same observations are applicable to luxations of the sternal end of the bone. Dr. James Cocke, of Baltimore, has reported, in vol. i. of *New York Med.* and *Phil. Journ.*, the successful reduction of a dislocation of the scapulary end. (*Reese's Amer. ed. of this Dictionary.*)

Dislocations of the Os Brachii.

Nature, which varies according to the necessities of different animals, the number of their joints, has also been provident enough to vary the structure of these parts, according to the use of the different portions of their economy. To great moveableness some unite considerable solidity; for instance, the vertebral column. Others are very strong, but only admit of a slight yielding motion, as we observe in the carpus, tarsus, &c. Lastly, other joints admit of a great latitude of motion; but their strength is easily overpowered by the action of external bodies. In man, such is the shoulder-joint.

Of all the very moveable articulations, not one is so often luxated as the shoulder-joint. Bichat mentions, that it appears, from a comparative table, that, in some years, this accident, at the Hôtel-Dieu, has been as frequent, and even more so, than dislocations of all the other bones taken collectively.

Here every thing seems to facilitate the escape of the bone from its natural cavity. An oval shallow cavity, surrounded by a margin of little thickness, receives a semi-spherical head, which is twice as broad as the cavity in the perpendicular direction, and three times as extensive from before backward. With respect to the ligaments, the joint is only strengthened by a mere capsule, which is thin below, where nothing opposes a dislocation; but thicker above, where the acromion, coracoid process, and triangular ligament, form an almost insurmountable obstacle to such an accident. With regard to the muscles and motions of this joint, strong and numerous fasciculi surround the articular surfaces; make them easily move in all directions; and, pushing the head of the os brachii against the different points of the capsule, distend this fibrous sac; and, when their power exceeds the resistance, actually lacerate it. As for external bodies, what bone is more exposed than the os brachii to the effect of their force?

Thus subjected to the influence of these predisposing causes, the os brachii would be in continual danger of being dislocated, if the scapula, which is as moveable as itself, did not furnish a point of support for it, by accompanying it in all its motions. This point of support accommodates itself to the variations in the position of the head of the os brachii, so that to the moveableness of the articular surfaces, their strength is in a great measure owing.

The shoulder-joint, which is very liable to luxations in a general sense, is not equally so at all points. The head of the humerus cannot be displaced upwards. Here are situated the acromion and coracoid process, the triangular ligament stretched between them, the tendons of the biceps, supraspinatus, and the fleshy portion of the deltoid; insurmountable obstacles to the luxation of the head of the bone upwards. Supposing there were a force calculated to produce such an effect, the head of the bone must necessarily be driven outward as well as upward, ere its head could be displaced. This seemed to Desault impossible, because the trunk prevents the lower part of the arm from being directed sufficiently inward to produce this effect. However, many cases of this dislocation are now upon record; and one, to which I shall presently advert, was caused by a direct blow on the forepart of the shoulder; a cause, which seems not to have been contemplated.

On the contrary, at the other margins of the glenoid cavity, there is little resistance. At the inferior one, the long portion of the triceps; at the internal one, the tendon of the subscapularis; and at the external edge, those of the infraspinatus, and teres minor, will allow primitive luxations to take place, downward, inward, or outward. Downward, between the tendon of the long portion of the triceps, and the tendon of the subscapularis, which last, in a case dissected by Sir A. Cooper, was ruptured (*Surg. Essays*, part i. p. 7.; and *On Dislocations*, p. 421, 422.); inward, between the fossa subscapularis, and muscle of this name; outward, between the fossa infraspinata, and infraspinatus muscle.

According to Sir Astley Cooper, the os humeri is liable to be thrown from the glenoid cavity of the scapula in four directions: three of these luxations are complete; the other is only partial. The first is *downwards and inwards*, the dislocation *into the axilla*, as it is usually called, in which case, the head of the bone rests upon the inner side of the inferior costa of the scapula. The second is *forwards, under the pectoral muscle*, the head of the bone being placed below the middle of the clavicle, and on the sternal side of the coracoid process. The third is the dislocation *backwards*, in which the head of the bone can be plainly felt and seen, as a protuberance at the back and outer part of the inferior costa of the scapula, upon the dorsum of this bone. The fourth, which is only partial, is when the front of the capsular ligament is torn, and the head of the bone rests against the outer side of the coracoid process. "Of the dislocation in the axilla (says Sir Astley Cooper) I have seen a multitude of instances; of that forwards, on the inner side of the coracoid process, several; although it is much less frequent than that in the axilla: of the dislocation backwards, I have seen only two instances during the practice of my profession for 38 years." (*On Dislocations, &c.* p. 416.)

Sometimes, after the head of the bone has escaped from the internal or inferior part of the capsule, it is carried behind the clavicle, forming a case of consecutive dislocation upward; a specimen of which was preserved in Desault's museum. But here the secondary displacement only takes place slowly; and when it occurs, a reduction can rarely be effected, on account of the strong adhesions, contracted by the surfaces of the bone. Thus, in the specimen referred to, a new cavity was formed behind the clavicle, and the humerus adhered by new ligaments to the surrounding parts.

The action of external bodies, directed against the arm, but particularly falls, in which this part is forced against a resisting body, gives rise to primitive dislocations; and then the different species of the accident are determined, by the particular position of the humerus at the instant when the injury takes place.

Should this bone be raised from the side without being carried either forward or backward; should the elbow be elevated, and the fall take place on the side, then the weight of the trunk, almost entirely supported by this bone, forces downward, its upper part, which stretches and lacerates the lower part of the capsular ligament. Thus a luxation downward is produced, and its occurrence may also be facilitated by the combined action of the latissimus dorsi, pectoralis major, and teres major, muscles, as Fabre has judiciously remarked; for being at this period involuntarily contracted to support the trunk, they act with the power of a considerable lever; the resistance being the head of the bone, which they draw downward, while the fixed point is the lower end of the bone, resting against the ground. Some authors also consider, as the immediate cause of a dislocation downward, the strong action of the deltoid, which is supposed to depress the head of the bone, and push it downward through the capsular ligament. In support of this opinion, Bichat mentions the well-known case of a notary, who luxated his arm downward in lifting up a register.

The rationale of the primitive luxation inward differs very little from that of the preceding case. The elbow is both separated from the side, and carried backward: in falling, the weight of the body acts on the humerus, the front part of the capsule is lacerated, and a luxation takes place in this direction.

The dislocation outward (or, as Sir Astley Cooper calls it, backward) is produced in the same sort of way. The elbow is carried forward, towards the opposite shoulder; the capsule is stretched outward; and if a sufficient force act on the limb, it is lacerated. But, how could such a force arise? In a fall, the arm being pushed against the trunk, and kept there, cannot move extensively enough to cause such a laceration. Hence, a luxation outward, or rather backward, under the spine of the scapula, must necessarily be rare; and Desault, in all his experience, never saw such an accident. Besides, when, in a fall, the arm is raised from the side, and inclined forward or backward, the weight of the body only operates upon it obliquely, and the limb is very little exposed to the action of the latissimus dorsi, pectoralis major, and teres major muscles. However, a few instances of dislocation of the head of the humerus in this direction have been recorded. Kirkland met with two cases, and reduced them. Sir Astley Cooper, in the course of 38 years, has met with two examples. In a dead subject, Boyer remarked a singular inclination of the glenoid cavity backwards, its articular surface, also, presenting on this side an extraordinary elongation, and the humerus readily slipping under the spine of the scapula. (*Mal. Chir.* t. iv. p. 176.)

A dislocation of the head of the humerus on the dorsum of the humerus was brought into the North London Hospital in 1835, and reduced by Mr. Morton, then one of the house surgeons. Two similar cases have also been reported from the Middlesex Hospital. (See *Lond. Med. Gaz.* for 1832, 1833, p. 478., and for 1833, 1834, p. 142.) In one of these examples, the accident occurred as follows: — The patient was reaching down a box from the top of another, which was on a bedstead. In doing this, her arm was extended upwards and forwards, the hand being placed so as to receive the box, when this suddenly slipped off the other, and she felt her right arm give way, and fall powerless by her side. The symptoms and mode of reduction will be presently noticed. In the other example, the patient, a woman, aged 94, trod upon some orange-peel, slipped, and fell on the forepart of the shoulder.

In the patient, whose history was published by M. Fizeau, and in whom a dislocation of the humerus outwards and backwards was seen both by that gentleman and Boyer, there was also the particularity, that the luxation was readily reproduced. (*Journ. de Méd. par Corvisart, &c.* t. x. p. 386.) Hence, Boyer suspects that this rare kind of displacement must have been facilitated by some preternatural disposition of the articular surfaces. Experience proves, however, that this is not an essential or even a common circumstance. No dislocation occurs more frequently, than that downward, in which the influence of the weight of the body, and of the action of the muscles, is direct. However, the luxation inward, or, as Sir Astley Cooper and others call it, forwards, is common.

In all primitive dislocations from violence, and not from paralysis of the deltoid, and a gradual yielding of the capsule, I believe the latter part is always extensively lacerated. In general, authors have paid too little attention to this circumstance, which dissections have repeatedly demonstrated. Desault had two specimens of it imitated in wax; one was in a dislocation inward; the other in a dislocation downward; both of which were met with in subjects who died at the Hôtel-Dieu. Bell also mentions similar facts; and another English surgeon, says Bichat, has observed the same occurrence. I suppose Bichat here alludes to Mr. Thompson, who long ago noticed the laceration of the capsule. (See *Med. Ob. and Inq.*) The case which he dissected, is perhaps the earliest *post mortem* examination of a dislocated shoulder; and the identical preparation is now in the museum of University College, London.

Desault conceives, that the capsule may be sufficiently torn to let the head of the bone escape; but that the opening may afterwards form a kind of constriction round the neck of the humerus, so as to prevent the return of the head of the bone into the place which it originally occupied. The correctness of this statement, however, is positively denied by Sir A. Cooper, who remarks that they who entertain this belief, must forget the inelastic structure of the capsular ligament, and never have witnessed by dissection the extensive laceration which it suffers in dislocations from violence. (*Surgical Essays*, part i. p. 18.)

Some further pathological observations on dislocations of the shoulder, will be hereafter laid before the reader.

Several causes may lead to a *consecutive* luxation. If a fresh fall happen, while the arm is separated from the trunk, the head of the humerus, which nothing confines, obeys, with the utmost facility, the power of displacing it in this manner, and is again pushed out of the situation which it accidentally occupies.

A man, in going down stairs, meets with a fall, and dislocates the humerus downwards: he immediately sends for Desault, who defers the reduction till the evening. In the mean time, the patient, in getting upon a chair, slips and falls again. The pain was more acute, than when the first accident occurred; and Desault, on his return, instead of finding the head of the humerus as it was in the morning, in the hollow of the axilla, finds it behind the pectoralis major muscle.

The action of muscles is a permanent cause of a new dislocation. When the humerus is luxated downward, the pectoralis major, and the deltoid, draw the upper part of this bone upward and inward, which, only making a weak resistance to their action, changes its position, and takes one in the above double direction.

The various motions imparted to the arm may also produce the same effect, according to their direction. Thus, in consequence of unskilful efforts to reduce the bone, a luxation inward frequently follows one downward. By the French surgeons, a great deal of importance has been attached to the division of dislocations of the humerus into primary and consecutive; and perhaps some of their statements, on the secondary change in the position of the head of the bone, may be exaggerated. That a subsequent alteration in the situation of the bone may happen, from the causes specified by Desault, can hardly be questioned. The observations of Petit, Hey, and others, confirm the fact; and I have myself seen a dislocation in the axilla change into one forward, under the pectoral muscle. However, Sir Astley Cooper believes that, excepting from violence, and the effect of absorption, the nature and direction of a dislocation are never changed, after the muscles have once contracted. (*On Dislocations*, p. 416.) Perhaps, with the latter qualification, no great difference prevails between him and other writers.

Symptoms.

Whatever may be the kind of dislocation, a depression is always manifest under the acromion, which forms a more evident projection, than in the natural state. Almost all the motions of the arm are painful; some cannot be performed in any degree; and they are all very limited. The arm cannot move without the shoulder moving also; because, the articulation being no longer able to execute its functions, both it and the shoulder form, as it were, one body. When the limb is moved, a slight crepitus may sometimes be felt, probably in consequence of the synovia having escaped through the laceration of the capsule. (*Sir A. Cooper on Dislocations*, p. 418.)

To these symptoms, generally characteristic of every sort of dislocation of the humerus, are to be added such as are peculiar to each particular case. When the luxation is downward, the arm is a little longer than in the natural state; the natural roundness of the shoulder is lost, in consequence of the deltoid muscle being drawn down with the head of the bone; and the patient cannot use the arm. The elbow is more or less removed from the axis of the body by the action of the deltoid, the long head of the biceps and supraspinatus muscle being also stretched, and tending to draw the bone outward. The pain, which arises from this position, compels the patient to lean towards the dislocated limb, to keep the forearm half bent, and the elbow supported on his hip, in such a way that the arm, having a resting place, may be sheltered from all painful motion, especially that of the elbow inwards. By this posture alone, Desault often recognised the accident. The head of the humerus may be felt in the axilla; but "only when the elbow is considerably removed from the side." (*Sir A. Cooper on Dislocations*, p. 417.) This last circumstance is worthy of notice, as the inability to feel the head of the bone has led to mistakes.

With the general symptoms of dislocations of the humerus, a luxation inward has the following: — The elbow is separated from the axis of the body, and inclined a little backward; the humerus seems to be directed towards the middle of the clavicle; motion backward is not very painful, but that forward is infinitely so; there is a manifest prominence below the clavicle under the great pectoral muscle; and the arm is said by Desault to be a very little longer than natural, but by Sir Astley Cooper to be somewhat shortened. (*On Dislocations*, p. 435.) The coracoid process is on the outer side of the head of the bone; which latter part, being lodged between the clavicle, second rib, and the coracoid process, the limb is even less moveable than in the dislocation into the axilla.

With regard to the foregoing disagreement, between the statements of Desault and our distinguished countryman, I find that Baron Dupuytren used to believe, that the elongation of the limb only occurred in the dislocation downwards below the glenoid cavity; but, in consequence of the researches of M. Malgaigne, and experiments made by himself, he was induced to alter his opinion on this point. M. Malgaigne observed, that, when the head of the humerus occupies the concavity of an arch, formed by the acromion, the coracoid process, and the coraco-acromial ligament, it must evidently be upon a lower level, whether under one or the other pillar of this arch. In a shoulder joint, the ligaments of which had been recently dissected, Dupuytren dislocated the head of the humerus under the coracoid process, and ascertained by a careful measurement, that the arm was lengthened about half an inch. (*Dupuytren, Clin. Chir.* t. iii. p. 93.)

In the dislocation inwards, or under the pectoral muscle, the cushion of the shoulder is less flattened, than in the dislocation downwards; and the elbow cannot be brought forwards without acute pain being produced. This case is much less common, than the dislocation downwards, and Dupuytren believed it to be seldom primitive, but almost always consecutive to the dislocation downward. (*Clin. Chir.* t. iii. p. 102.) A dissection by Mr. Crampton, however, leaves no doubt about the possibility of a dislocation inwards being sometimes primitive. (See *Dubl. Journ. of Med. Science*, vol. iii. p. 47.); a fact, which even Dupuytren's own description of the manner in which the accident is usually caused, would render sufficiently certain. If this dislocation commonly occur from a fall on the elbow, while separated from the side and inclined backwards (*Dupuytren*, t. iii. p. 101.), does not this imply that, under these circumstances, the head of the bone is propelled inwards, or forwards, so as to lacerate the capsule in that direction?

Were a dislocation outward to present itself, it would be particularly characterised by a hard tumour under the spine of the scapula; and by the somewhat increased length of the arm. The motions of the arm would be impaired, but not in so great a degree as in the foregoing cases. In one example, related by Mr. Toulmin, of Hackney, the arm could be moved considerably either upwards, or downwards; but, motion forwards, or backwards, was very limited. And from the observations of Mr. Coley, of Bridgenorth, it would seem, that this dislocation may be attended with the peculiarity of the arm lying close to the side. (*Sir A. Cooper on Dislocations*, p. 441—443.)

In the cases, brought to the Middlesex Hospital, the arm hung by the side, without being directed forwards or outwards. (See *Lond. Med. Gaz.* 1832, 1833, p. 478. and 1833, 1834, p. 142.) The same fact was noticed in the case reduced by Mr. Morton in the North London Hospital. The shoulder is merely flattened in front. (*Dupuytren, Clin. Chir.* t. iii. p. 102.)

The principle was formerly inculcated, that all dislocations of orbicular joints, were *complete;* but, Sir Astley Cooper and Baron Dupuytren have proved, that dislocations of the shoulder may be *incomplete;* and the latter makes a similar statement also with regard to dislocation of the hip. (*Clin. Chir.* t. iii. p. 104.) The case, adduced in proof of this last observation, seems to have been the effect of disease. But, without disease the head of the humerus may burst through the anterior part of the capsule, and without entirely quitting the articular cavity, lie upon the outer side of the coracoid process. A vacancy is chiefly perceived at the posterior part of the glenoid cavity.

The distinguishing circumstances, between a dislocation and a fracture of the upper part of the humerus, should be well understood; for, were the surgeon to mistake a dislocation for a fracture, and neglect to reduce the bone, he would render himself liable to very heavy damages, and the loss of his professional prospects. Let it be remembered, therefore, that, in the dislocation downwards, 1. The arm is considerably lengthened; whereas, in a fracture of a living bone, if there is no displacement, the limb is of its natural length; but, when there is displacement, as one end of the fracture rides over the other, the limb must be shortened. Thus, in one instance of such dislocation under Dupuytren, a measurement of the distance between the point of the acromion and the olecranon, and one of the condyles of the humerus, showed that it was one French half inch greater in the injured limb than in the other. In an experiment upon a recently dissected shoulder-joint, the elongation was found to exceed an inch and a half. (*Clin. Chir.* t. iii. p. 94.) The reason of this difference seems to me to have depended upon the first measurement being made in a case which had existed some time; and, I believe, that in a recent dislocation downwards, the elongation must be greater than the half inch noticed by Dupuytren in the particular instance referred to. This point alone, being ascertained, may satisfy every practitioner, as it always did Dupuytren, that the case is certainly not a fracture. 2. Another distinction, necessarily resulting from the foregoing, and pointed out by M. Malgaigne, consists in the increased breadth or depth of the portion of the great pectoral muscle, constituting the front boundary of the armpit. Thus, if the distance between the lower edge of the clavicle and lower and front margin of the armpit be measured, it will be found to be at least half an inch greater, than on the opposite side of the body. 3. The head of the humerus must necessarily form a prominence below the clavicle, or, as Sir A. Cooper has stated, in the axilla, if the arm be raised. 4. The deltoid readily yields, and is pressed inwards, when the fingers are applied to it under the acromion. These four symptoms, which never attend a fracture, were demonstrated in one patient under Dupuytren, in a theatre crowded with students. (See *Dupuytren, Clin. Chir.* t. iii. p. 84.)

Many authors speak of an œdematous swelling of the upper extremity, as a frequent consequence of a dislocation inward. In the time of Desault and Bichat, this occurrence was not often noticed at the Hôtel-Dieu, except in very old luxations; and when it was, beneficial effects were obtained, in certain instances, by applying, for a few days, a moderately tight bandage from the fingers up to the axilla.

One consequence, mentioned by Avicenna, is a palsy of the upper extremity, arising from the pressure, made by the head of the bone, when dislocated inward, upon the axillary plexus of nerves. Indeed, when the nerves have been long compressed, this affection is very difficult of cure. In this case, Desault used to apply the moxa above the clavicle. The success, which was experienced by some patients, did not invariably follow in others. But, when the head of the humerus has only made a momentary pressure on the nerves, the paralysis often goes off of itself, and its dispersion may always be powerfully promoted by the use of liniments containing ammonia.

Of the Reduction.

We may refer to two general classes, the infinitely various means for the reduction of a dislocated humerus. The first are designed to push back, by some kind of mechanical force, the head of the bone, into the cavity from which it is displaced, either with or without making previous extension. The others are merely intended to disengage the head of the bone from the place which it accidentally occupies, leaving it to be put into its natural situation by the action of the muscles. The first all act nearly in the following manner: — Something, placed under the axilla, serves as a fulcrum, on which the arm is moved as a lever, the resistance being produced by the dislocated head of the humerus, while the power is applied either to the lower part of this bone, or the wrist. The condyles of the humerus being pushed downward and inward, the head of the bone is necessarily moved in the opposite direction, towards the glenoid cavity, into which it slips with more or less facility. Thus operated the machine, so celebrated, among the ancients and moderns, under the name of the ambi of Hippocrates; whether used exactly in the form described by him, or with the modifications devised by Paul of Ægina, Ambrose Paré, Duverney, Freke, &c.

Extension removes the bone from its unnatural situation, and has been executed in different ways. Sometimes, the weight of the body on one side, and the dragging of the end of the dislocated bone on the other, tend to produce this effect. Such was the action of the ladder, door, &c. described in Hippocrates's Treatise on Fractures, and repeated in modern works. Sometimes, the trunk is fixed in an unchangeable manner, while the arm is extended, as is practised in employing the machine of Oribasius, one of the methods formerly adopted in public places, where wrestlers combated. Sometimes, no extension is sensibly executed; and while the end of the humerus is pushed outward by a body placed under the axilla, the surgeon pushes it upward into the glenoid cavity.

The following are the objections common to all these contrivances: — However well covered the body placed under the axilla may be, to serve as a fulcrum, there is always a more or less inconvenient chafing, frequently dreadful stretching and laceration of parts, in consequence of its application, when the trunk is suspended upon it, as in the instance of the door, &c. In this way, Petit saw a fracture of the neck of the humerus produced, and even a laceration and aneurism of the axillary artery.

When the luxation is consecutive, how can mechanical means bring back the head of the bone, through the track it has taken? For instance, if a dislocation inward has succeeded one downward, the head of the bone must be brought down, before it can be replaced.

If these means were ever safely employed, it was when a primitive luxation downward was quite recent, and the head of the bone very near the glenoid cavity.

Desault often employed the following method: — While the patient was seated upon a chair of moderate height, he took hold of the hand on the affected side, placed it between his knees, which he moved downward and backward, in order to make the extension and disengage the head of the bone, while an assistant held back the trunk to effect the counter-extension. This was sometimes executed by the weight of the body, and effort of the patient. At the same time, the surgeon's hands were applied to the arm, in such a way, that the four fingers of each were put in the hollow of the axilla, and the thumbs on the outer part of the arm, which being pushed upward, and a little outward, the head of the humerus usually returned with ease into its natural cavity.

Petit describes this plan, but combined with the use of a napkin, passed under the patient's axilla, and over the surgeon's neck, who raises the dislocated end of the bone, by extending his head.

When the luxation downward was very recent, Desault occasionally reduced it, by a still more simple process; namely, by placing his left hand under the axilla, to serve as a fulcrum, while with the right, applied to the lower and outer part of the arm, he depressed the humerus towards the trunk, and at the same time raised the upper part of the bone. The head of the humerus, directed upward and outward by this double motion, returned into the glenoid cavity without the least resistance.

The facility, with which the humerus may often be reduced, when the patient is faint, or intoxicated, or taken by surprise, is well known to every surgeon of experience. In one case, Mr. Hey desired the assistants to keep the arm elevated at a right angle with the body, preparatory to the commencement of the extension. In doing this, they kept the arm a little upon the stretch, and, while the arm was in this state, he placed his fingers below the head of the bone, that he might be ready to co-operate with them; and pressing his fingers upwards into the axilla, that he might feel the head of the bone distinctly, the reduction was unexpectedly accomplished by this gentle effort. (See *Hey's Surgery*, p. 295. ed. 2.) A similar case follows at p. 296. He once saw a luxated shoulder reduced by the mere efforts of the patient, an elderly man, who, after placing his hand upon the back of a low chair, and moving his body in different directions, suddenly cried out as if hurt more than usual. He then sat down, and said that he was easy, and could move his arm better: in fact, the os humeri had returned into the glenoid cavity.

Reduction, by means of the surgeon's heel in the patient's axilla, is commended by Sir Astley Cooper as the best in three-fourths of recent dislocations. The patient (he observes) should be placed in the recumbent posture, upon a table, or a sofa, and near its edge. "The surgeon then binds a wetted roller round the arm, immediately above the elbow, upon which he ties a handkerchief. Then, with one foot resting on the floor, he separates the patient's elbow from his side, and places the heel of his other foot in the axilla." The arm is then steadily drawn with the handkerchief for three or four minutes, at the end of which, the bone in common cases is easily replaced. If more force be required, a long towel can be used, with which several persons may pull. Sir Astley Cooper generally bends the fore-arm nearly to a right angle with the os humeri, because this position relaxes the biceps, and lessens its resistance: in many cases, however, he makes the extension at the wrist; a plan, in which he finds more force requisite, but the bandage is less apt to slip.

Another simple mode of reduction, which Sir Astley Cooper considers proper for recent dislocations, delicate females, and very old, relaxed, emaciated persons, is that by means of the surgeon's knee, as a fulcrum, in the patient's axilla. The patient is placed on a low chair, on the side of which the surgeon rests his foot, while he takes hold of the os humeri just above the condyles, and applies his other hand to the acromion. The arm is then drawn down over the knee, and the head of the bone returns into its place. (*On Dislocations*, p. 432.)

In some cases, the preceding methods are inadequate, and greater extension must be made. The following was the practice of Desault: —

The patient is laid upon a table covered with a mattress; a thick linen compress is applied to the axilla, on the side affected, and upon this compress the middle of the first extending bandage is placed, the two heads of which ascend obliquely before and behind the chest, meet each other at the top of the sound shoulder, and are held there by an assistant, so as to fix the trunk, and make the counter-extension. The action of this bandage does not affect the margin of the pectoralis major and latissimus dorsi, in consequence of the pad projecting over them. If this were not attended to, these muscles being drawn upward, would pull the humerus in this direction, and thus destroy the effect of the extension, which is to be made in the following manner: —

Two assistants take hold of the forearm, above the wrist; or else the towel, doubled several times, is to be applied to this part. The two ends are to be twisted together, and held by one or two assistants, who are to begin pulling in the same direction in which the humerus is thrown. After this first proceeding, which is designed to disengage the head of the bone from its accidental situation, another motion is to be employed which differs according to the kind of luxation. If this should be downward, the arm is to be gradually brought near the trunk, at the same time that it is gently pushed upward. Thus, the head of the bone being separated from the trunk, and brought near the glenoid cavity, usually glides into this situation with very little resistance.

When the luxation is inward, after the extension has been made in the direction of the humerus, the end of this bone should be inclined upward and forward, in order that its head may be guided backward; and *vice versâ*, when the luxation is outward.

When the head of the bone has been disengaged by the first extension, the motion, imparted to it by the rest of the extension, should in general be exactly contrary to the course which the head of the bone has taken, after quitting the glenoid cavity. When there is difficulty experienced in replacing the head of the bone, we should, after making the extension, move the bone about in various manners, according to the different direction of the dislocation, and the principle just noticed. This plan often accomplishes what extension alone cannot; and the head of the bone, brought by such movements towards its cavity, returns into it, during their execution.

When the dislocation is consecutive, the first extension, made in the direction of the displaced bone, brings back its head to the situation where it was primitively lodged, and the case is then managed just as if it were a primitive dislocation. (*Desault.*)

When the muscles are very powerful, or the displacement has continued several days, Sir Astley Cooper, instead of the treatment by the heel in the axilla, recommends the patient to be put upon a chair, and the scapula to be fixed by means of a bandage, which allows the arm to pass through it, and is buckled on the top of the acromion so that it cannot slip downward. A wetted roller is next applied round the arm, just above the elbow, and over the roller a strong worsted tape, fixed with what the sailors term the *clove-hitch* knot. The arm should now be raised to a right angle with the body; and, if much difficulty be experienced, *even above the horizontal line, in order to relax more completely the deltoid and supraspinatus muscles* Two persons are then to pull the worsted tape, and two the scapula bandage, in opposite directions, with a steady, equal, and combined force. After the extension has been kept up a few minutes, the surgeon is to place the knee in the axilla, with his foot resting upon the patient's chair; he now raises his knee, while he pushes the acromion downwards and inwards, and the head of the bone usually slips into the glenoid cavity. Sometimes, Sir Astley Cooper has seen a gentle rotatory motion of the limb, made during the extension, bring about the reduction.

In old cases, and others attended with great difficulty from the powerful contraction of the muscles, Sir Astley prefers making the extension with pulleys, because with them, when the resistance is likely to be long, jerks and unequal force are more likely to be avoided than in the preceding method of reduction; and the assistants less apt to be fatigued. The patient sits between two staples, which are screwed into the sides of the room; the bandages are then applied precisely in the same way as when the extension is made without pulleys; and the force is applied in the same direction. The surgeon is to pull the cord of the pulley gently and steadily until pain is complained of, when he is to maintain the extension already made, but not increase it. During this stop, he should converse with the patient, and direct his mind to other subjects. In two or three minutes, more force should be applied and very gently increased, until pain be again complained of, when another stop should be made. The surgeon should proceed in this way for a quarter of an hour, at intervals slightly rotating the limb. When the extension seems great enough, an assistant should hold the cord of the pulley, and keep up the degree of extension, while the surgeon puts his knee into the axilla, and resting his foot upon the chair, gently raises and pushes back the head of the bone towards the glenoid cavity, into which it generally returns without the snap usually heard when the reduction is effected by other means. Sir Astley Cooper precedes the use of the pulleys with venesection, the warm bath, and a grain of tartarised antimony every ten minutes, until faintness is produced, as already noticed in our general remarks. (*On Dislocations*, p. 942.)

When considerable extension is required, Mr. Crampton prefers the power of a lever to that of a pulley. The lever, he observes, is always at hand, "as there are few places, in which a pole, or a ladder, cannot be readily procured; but, its superiority over the pulley consists in the facility with which the direction of the extending force can be varied, while the force is still maintained, and the suddenness with which the force can be withdrawn as soon as it has produced its effect." (See *Dubl. Journ. of Med. Science*, vol. iii. p. 183.) Mr. Crampton's mode of employing the ladder is entirely different from that of the ancients. It is employed merely as a lever; with one end, fixed on the ground by a person's foot; while the surgeon takes hold of the other end, its direction is obliquely upwards from the ground; the patient stands with his legs introduced between the transverse pieces of it; a bandage connects the wrist to the point of the ladder, in the proper direction of the extension; and counter-extension is made with a folded sheet, or table-cloth.

When the head of the humerus is dislocated forwards, or under the middle of the clavicle, Sir Astley Cooper recommends the biceps to be relaxed, and the extension to be made obliquely downwards and a little backwards. In most instances of this kind, he says, the plan of reduction, by means of the heel in the axilla, will also succeed, care being taken to apply the foot rather more forward than in a dislocation into the axilla, so that it may press on the head of the bone. However, when the dislocation has continued several days, he considers gradual extension with pulleys necessary. As soon as the head of the bone has been drawn below the level of the coracoid process, it is to be pressed backwards with the surgeon's heel or knee, and the elbow at the same moment pulled forwards. (*Op.* cit. p. 439.)

When the head of the bone had deserted the axilla, and slipped under the pectoral muscle, Mr. Hey found, that it could be more readily brought back into the axilla by making the extension in the direction opposite to that in which it has passed from the axilla: "This effect is often greatly promoted by making the extension with the arm elevated, as Mr. White has advised." (See *Hey's Surgery*, p. 298. ed. 2.)

The dislocation on the dorsum of the scapala appears, from some cases in Sir Astley Cooper's work, to be reducible by nearly the same mode of extension as that employed for the reduction of the dislocation in the axilla. Mr. Coley, of Bridgenorth, who met with two cases of luxation backwards, advises the reduction to be effected by elevating the arm, and rotating it outwards, so as to roll the head of the humerus towards the axilla, when it is to be kept in this position while the arm is brought down into a horizontal direction: on the extending force being now applied, the bone is easily reduced. (*Op.* cit. p. 444.) In one case in the Middlesex Hospital, "The patient was seated on the ground, with the sound side close to a wall, in which was a staple on a level with the shoulder, to which the apparatus for fixing the trunk and scapula was attached. Extension was made by two men by means of a cloth attached to the humerus, the direction of which was forwards, outwards, and a little upwards, the surgeon standing behind the patient, and retaining the scapula from yielding forwards. After hanging on for some time, and then by a more forcible extension, the head of the bone slipped into its socket with a snap. An effort at the reduction by one man on the towel had previously failed." (See *Lond. Med. Gaz.* 1832, 1833. p. 479.) The case in the North London Hospital was reduced by Mr. Morton with the utmost facility.

In the partial dislocation forwards, or that where the head of the bone lies at the scapular side of the coracoid process, the mode of reduction is the same as that employed in the complete dislocation forwards; but it is necessary to draw the shoulders backwards; and as soon as the reduction is accomplished, the bone is to be kept from slipping forwards again by maintaining the shoulders in that position with a bandage. (*Sir Astley Cooper, Op.* cit. p. 449.) The elbow and fore-arm should also be supported, as much forward as possible, in a sling.

In Dublin, the extending power is applied to the wrist, as in France and Germany. (*Ph. Crampton, Dubl. Journ.* vol. iii. p. 182.) This gentleman also expresses a doubt about the possibility or advantage of fixing the scapula.

In Sir Astley Cooper's valuable work is recorded a case of compound dislocation of the shoulder, which was under the care of Messrs. Saumarez and Dixon, of Newington, and was cured by anchylosis. (P. 450.) Such an accident must be treated on the same principles as other severe compound dislocations.

For the purpose of preventing the head of the bone from slipping out of its place again, the arm should be kept for some days quiet, the elbow bandaged close to the side, and supported in a sling. Sir Astley Cooper recommends a cushion to be put into the axilla and a stellate bandage and sling to be applied. (*On Dislocations*, p. 432.) After the reduction of a dislocation, which has happened downward, the facility of a fresh displacement is said to depend very much upon the extent, to which the tendon of the subscapularis muscle has been lacerated. (*Sir A. Cooper's Surgical Essays*, part i. p. 7.)

Pott and Sir Astley Cooper are of opinion, that the narrowness of the opening in the capsular ligament can never create any impediment to the reduction. But Desault and Hey (*Pract. Obs.* p. 301. ed. 2.), entertained the opposite opinion, and hence the former was an advocate for moving the head of the bone about very freely, with the view of lacerating the capsule more extensively. Messrs. Logan and Hey, of Leeds, sometimes succeeded with slight extension, and gentle motion of the bone in various directions. This practice answered in several cases, where the head of the humerus had passed far under the pectoral muscle. (See *Hey's Surgery*, p. 311. ed. 2.)

Mr. C. White, of Manchester, also believed, that the reduction was sometimes prevented by the head of the bone not being able to get through the laceration in the capsule again. He succeeded in reducing some cases, which he supposed to be of this nature, in the following manner:—Having screwed an iron ring into a beam at the top of the patient's room, he fixed one end of the pulleys to it, and fastened the other to the dislocated arm by ligatures attached to the wrist, placing the arm in an erect position. In this way, he drew up the patient, till his whole body was suspended; but, that too much force might not be sustained by the wrist, Mr. White at the same time directed two other persons to support the arm above the elbow. He now used to try with his hands to conduct the arm into its place, if the reduction had not already happened, as was sometimes the case. Occasionally a snap might be heard, as soon as the patient was drawn up; but the reduction could not be completed, till he was let down again, and a trial made with the heel in the armpit. When no iron ring was at hand, Mr. White used to have the patient raised from the ground by three or four men, who stood upon a table. (*Cases in Surgery*, p. 95.)

There can be little doubt, that the success of Mr. C. White's plan was not owing to its action on the opening in the capsule, but depended upon another principle, first explained by Sir Astley Cooper, and mentioned in the foregoing column in italics, that it may receive due attention. Mr. Crampton takes a similar view:—"If it be true (says he) that, in some cases, the supraspinatus muscle, retaining its connection with the greater tubercle, is the cause of the resistance to the extending power, (*Sir A. Cooper on Dislocations*, p. 377.) it is obvious, that this resistance can be best overcome by raising the arm, and thus relaxing the opposing muscle. The process, which not unfrequently attends the method of reduction, first recommended by Mr. White, of Manchester, by drawing the arm directly *upwards*, in a line parallel to the axis of the trunk, *is no doubt to be attributed to the relaxation* which it effects *of the supraspinatus and deltoid muscle.* It is probable, also, that, in this position of the humerus, the head of the bone is in some measure unlocked from the neck of the scapula, against which it is, when dislocated downwards, strongly compressed by the contraction of the muscles." (*Crampton in Dublin Journ. of Med. Science*, vol. iii., p. 181.) Mr. Hey, also, sometimes adopted White's method for old dislocations, especially those under the pectoral muscle. The usefulness of raising the arm to lessen the pressure of the edge of the glenoid cavity against the neck of the humerus is likewise particularly pointed out by him. (*Pract. Obs. on Surgery*, p. 299., ed. 2.) According to Mr. Crampton, the practice was at one time common in Steevens's Hospital, as the large ring in the cross beam of the anti-room testifies. In relation to the merit of the first introduction of this plan, Mr. Crampton justly assigns it to Mr. Charles White:—"The British surgeon (he observes) will be a little surprised to find this method introduced as a new and important mode of reduction in the Hôtel-Dieu. M. Malgaigne, the gentleman, who introduced the practice to the notice of Dupuytren, stated, that the anatomy and pathology of this kind of dislocation had led him to adopt the method, before he was acquainted with the method of Mothe (White?). The method of Mothe, as stated by M. Malgaigne, 'consists in making extension, the arm being lifted up forcibly, and consequently shortened, instead of extending the limb in a depressed, or elongated position.' (*Crampton, in Dublin Journ. of Med. Science*, vol. iii. p. 182.) M. Mothe's memoir was presented to the Academy of Surgery in 1785. Mr. White's paper was printed in 1764. It is but justice to M. Malgaigne to mention, that, Mr. Crampton has here supposed, that Mr. White's first suggestion of the practice, has not been admitted by M. Malgaigne. On the contrary, he states, that the anatomy and pathology of the shoulder-joint led him to adopt the practice, before he had become acquainted with White's observations, who had formerly resorted to it, though only in old dislocations. (See *Gaz. Méd. de Paris*, Sept. 1832.) He only proposed it also as "*une Methode inusitée en France.*" (See *Dupuytren Clin Chir.* t. iii., p. 86.) I am glad to have had this opportunity of doing justice to M. Malgaigne, whose observations on many parts of surgery reflect the highest honour upon him: and even on this subject, he comes off with reputation; for, though it was Mr. Charles White, that first adopted the practice, it was Sir Astley Cooper, and M. Malgaigne, who first gave a scientific description of the principles, on which its efficiency depends.

An important fact, noticed by M. Malgaigne, and exemplified at the Hôtel-Dieu, is, that after an old dislocation of the shoulder has been reduced, the arm may still remain longer than the other, and the head of the humerus rather more below the acromion. (See *Dupuytren, Clin. Chir.* t. iii. p. 90.) The circumstance is ascribed to the diminution of the depth and capacity of the glenoid cavity, and other pathological changes. But, whether such lengthening of the limb is observable after the reduction of every dislocation of the shoulder of some standing, M. Malgaigne admits to be a question, that has not yet been settled.

When the resistance of the muscles is very great, the means to be adopted are such as weaken the patient; bleeding, the warm bath, nauseating doses of tartarised antimony, opium, &c. Should the patient happen to be intoxicated at the time of his being first seen by the surgeon, the opportunity would be very favourable to reduction, as the muscles would then be capable of less resistance. Extension unremittingly, but not violently, continued for a length of time, will ultimately fatigue the resisting muscles, and overcome them with more safety and efficacy, than could be accomplished by any sudden exertion of force.

The swelling about the joint, brought on by the accident, usually disappears without trouble.

Another consequence, which seldom occurs, but which Desault saw twice, is a considerable emphysema, suddenly originating while powerful extension is made for the reduction of a dislocation of long standing. A tumour suddenly makes its appearance under the great pectoral muscle, and rapidly spreads towards the armpit, the whole of which it soon occupies. It reaches backward; and, in a few minutes, becomes as large as a child's head. A practitioner, unacquainted with this accident, might take it for an aneurism from a rupture of the axillary artery; but the elasticity of the tumour, its fluctuation, the situation where it first appears under the great pectoral muscle, and not in the axilla; the continuance of the pulse; and the unchanged colour of the skin, plainly denote that it is not a rupture of the artery. (*Œuvres Chir. de Desault*, t. i.) For dispersing the swelling, the lotio plumbi acetatis, and gentle compression with a bandage, are recommended.

Pathology of Dislocations of the Humerus from the glenoid Cavity of the Scapula.

I believe that the observation of Mr. Crampton is correct, that at the period, when Mr. Hey published the second edition of his Practical Observations on Surgery, in 1810, there was but one case on record, in which the actual state of the joint, in a *recent* dislocation of the shoulder, had been described and delineated. (*Case by H. Thompson*, in *Med. Obs. and Inq.* vol. ii. 1761.) Indeed, in this example, eighteen days had elapsed between the reception of the injury and the *post mortem* examination of the joint. In 1782, Professor Bonn gave the anatomy of several cases of unreduced dislocation of the humerus, but the most recent was of two years' standing. (*Comm. de Humero Luxato; Ph. Crampton*, in *Dublin Journ. of Med. Science*, vol. iii. p. 43.) Hey once saw a compound dislocation of the os humeri, the head of the bone being pushed through the integuments in the axilla; and, in that case, the long tendon of the biceps was torn from its groove; and the tendons of the supraspinatus and infraspinatus separated from the bone, a large shell of which was also torn off. (See *Hey's Surgery*, p. 811. ed. 2.) Mr. H. Thompson's dissection is remarkable, as being the oldest on record, and the identical parts are now preserved in University College museum. The tendon of the long head of the biceps was found violently stretched. The head of the bone was lodged at the inner side of the neck of the scapula, below the root of the coracoid process, between the subscapularis and serratus magnus. A portion of the humerus, including the greater tubercle, was broken off; and, of course, the supraspinatus, infraspinatus, and teres minor, detached. The subscapularis was also torn from its attachment to the lesser tubercle; but both this muscle and the teres minor retained a connection with the periosteum and bone through their external fibres. The neck of the humerus was embraced behind by the subscapularis, and in front by the teres minor. Thompson suspected, that, in some cases, this might make a difficulty in the reduction; and hence, he was an advocate for raising the arm and turning it inwards, so as to relax the subscapularis. He also suspected, that the tendency to a return of the dislocation, sometimes exemplified, might depend on the extensive laceration of the capsular ligament, and the teres minor and subscapularis muscles. (See *Med. Obs. and Inq.* vol. ii.) Sir Astley Cooper dissected two cases of recent dislocation downwards. In one, on removing the integuments, a quantity of extravasated blood presented itself in the subcutaneous cellular tissue and that covering the axillary plexus of nerves, as well as between the muscles. The axillary artery and plexus of nerves were thrown out of their course by the dislocated head of the bone, which was pushed backwards upon the subscapularis muscle. The deltoid was drawn down by the head of the bone. The supraspinatus and infraspinatus were stretched over the glenoid cavity and inferior costa of the scapula. The teres major and minor had undergone but little change of position. The coraco-brachialis was uninjured. In the space between the axillary plexus and coraco-brachialis, the head of the bone appeared. The capsular ligament was torn along the whole of the inner side of the glenoid cavity, and *the opening would have admitted a much larger body than the head of the humerus.* The tendon of the subscapularis, covering the capsule, was also extensively torn. The opening of the ligament, through which the tendon of the long head of the biceps passed, was somewhat lacerated, but the *tendon itself was not ruptured.* The head of the os humeri was thrown on the inferior costa of the scapula, between it and the ribs; and the axis of its new situation was about *an inch and a half below that of the glenoid cavity.* The subject of the second examination was a woman, fifty years of age, who had had the dislocation in the axilla five weeks, and seemed to have *died of violence used in the extension.* The pectoralis major was slightly lacerated, and blood effused; the supraspinatus was lacerated in several places; and the infraspinatus and teres minor torn, but less extensively. Some of the fibres, of the deltoid, and a few of those of the coraco-brachialis had also suffered; but *none of the muscles were so much injured as the supraspinatus.* The capsular ligament had given way in the axilla *between the teres minor and subscapularis muscles;* the tendon of the subscapularis was torn through at its insertion into the lesser tubercle; and the head of the bone rested upon the axillary plexus of nerves and the artery. Sir Astley Cooper next endeavoured to reduce the bone; but finding the resistance too great, he became anxious to ascertain its origin, and divided one muscle after another, cutting through the coraco-brachialis, teres major and minor, and infraspinatus; still the opposition was but little changed. He then conceived, that the deltoid muscle was the cause of failure, and relaxed it by elevating the arm. He next divided the deltoid, and then found the supraspinatus his great opponent, *until he drew the arm directly upwards, when the head of the bone* glided into the glenoid cavity. His inference is, therefore, that *the deltoid and supraspinatus are the muscles, which most powerfully resist the reduction.* He considers, also, that the best direction for the extension is that of a right angle with the body, or quite horizontally. "This dissection (says he) explains the reason, why the arm is sometimes easily reduced by raising it suddenly above the horizontal line, and placing the fingers under the head of the bone;" namely, because the muscles of opposition are relaxed. (See *Sir Astley Cooper on Dislocations*, p. 386—389. ed. 4.)

To these interesting cases, which illustrate many important points relative to the dislocation downward, Mr. Crampton has lately added two others; one of a recent dislocation downward; the other of a recent dislocation forwards under the pectoral muscle, on the sternal side of the coracoid process. In the first which occurred in 1808, a labouring man was brought into the county of Dublin Infirmary in a dying state from injuries received by the fall of a wall upon him. After death, which happened in about a couple of hours, the right shoulder-joint, which was dislocated, was carefully dissected, and a drawing made of it. On removing the integuments of the axilla, the cellular membrane, which was extensively enchymosed, formed a kind of cap, closely embracing the head of the os humeri, which was lodged on the inferior costa of the scapula, or rather on its neck. The *head of the bone*, in escaping from its socket, had *pushed the teres minor downwards,* and *burst through the lower part of the subscapularis muscle, some of the fibres of which closely embraced the neck of the bone, while the bulk of the muscle was pushed upwards, and detached from the inner surface of the scapula.* The short head of the biceps and the coraco-brachialis were forced to describe a curve outwards over the neck of the humerus on the sternal side, while the long head of the triceps crossed the neck of the bone obliquely on the dorsal side. The *tendon* of the *long head of the biceps remained in its groove;* but the sheath, in which it runs, was partially ripped up. The capsular ligament was completely torn from the lower part of the neck of the humerus to the extent of more than half its circumference. The great nerves and blood vessels were forced to describe a curve backwards by the pressures of the head of the bone, which was in contact with them, The tendons of the supraspinatus, infraspinatus. and teres minor, were completely torn off from the humerus, carrying with them the surface of the greater tubercle. Mr. Crampton endeavoured to find out what would have caused, in this case, the chief opposition to the reduction, which of course could not be the muscles attached to the greater tubercle, which was broken off; and he found, that keeping the hand in the supine position created a difficulty by causing the biceps and triceps to get behind the head of the bone. How this position of the radius, however, could in any way affect the triceps, which is inserted into the olecranon, seems to me rather difficult to comprehend. (See *Dublin Journ. of Med. Science*, vol. iii. p. 44.)

With respect to the state of the parts, in the dislocation forwards, the head of the bone is thrown on the inner side of the neck of the scapula, between it and the second and third ribs. In an old case dissected by Mr. Key, and preserved in the museum at St. Thomas's Hospital, the head of the bone was thrown on the neck and part of the venter of the scapula, near the edge of the glenoid cavity, and immediately under the notch of the superior costa. Nothing intervened between the head of the humerus and scapula, the subscapularis being partly raised from its attachment to the venter. The head was situated on the inner side of the coracoid process, and immediately under the edge of the clavicle, without the slightest connection with the ribs. Indeed, this must have been prevented by the situation of the subscapularis and serratus magnus between the thorax and humerus. The tendons of all the muscles, attached to the tubercles, and the tendon of the biceps, were perfect. The glenoid cavity was completely filled up by ligamentous structure, to which the tendons of the muscles, attached to the greater tubercle, adhered by means of bands, while in the substance of those tendons a sesamoid bone had been formed to prevent the effects of friction in the motions of the arm. The newly formed socket reached from the edge of the glenoid cavity to about one third across the venter; and *its surface was irregularly covered with cartilage.* The form of the head of the bone was considerably altered, and the cartilage in many places absorbed. There was a complete new capsular ligament. The pectoralis minor must have passed over the neck of the bone. (See *Ch. Aston Key*, in *Sir A. Cooper on Dislocations*, p. 400. ed. 4.)

The only recorded dissection, perhaps, of the dislocation forwards in the recent state, is that published by Mr. Crampton. It is remarkable, also, as being an instance of *primary* dislocation forwards, *the head of the bone having been thrown at once on the neck of the scapula, without previously passing into the axilla.* The dislocation was *unattended with the rupture of any muscle*, or the separation of any tendon from its insertion into the bone. The head of the humerus was lodged on the cervix of the scapula at the root of the coracoid process, but extending nearly as far as the notch in the superior costa. It *had passed out through a rent in the capsular ligament, over the upper edge of the tendon of the subscapularis*, detaching this muscle from its connection with the venter of the scapula, and *pushing its fibres downwards*, so that they formed a curve, *which partly embraced the neck of the humerus.* The supraspinatus and infraspinatus, were on the stretch, but not lacerated. *The opening in the capsular ligament was produced by a separation of it from the interior side* of the *brim of the glenoid cavity from top to bottom, and bounded on the top by the tendon of the supraspinatus, and at the bottom, by the inferior edge of the tendon of the subscapularis.* It was of sufficient extent, but no more, to *permit the head of the bone to return easily through it.* The interior part of the capsular ligament, corresponding to the axilla, was perfect. The great blood-vessels and nerves lay on the sternal side of the head of the humerus, *the axis of which was scarcely a quarter of an inch higher*, than that of the glenoid cavity. (See *Ph. Crampton*, in *Dublin Journ. of Med. Science*, vol. iii. p. 47.) The foregoing case settles the long-disputed question, whether the dislocation forwards is ever *primitive?*

When a dislocation remains long unreduced, the head of the bone towards the scapula becomes flattened, and it becomes furnished with a complete capsule. The glenoid cavity is filled up by a ligamentous substance, in which are found small portions of bone. A new articular cavity is formed on the inferior costa of the scapula. (See *Sir A. Cooper on Dislocations*, p. 389. ed. 4.)

I shall conclude the subject of luxations of the shoulder with the following singular observation, recorded by Baron Larrey: —

"Among the curious anatomical preparations, (says he) which I saw in the cabinet of the university of Vienna, there was a dissected thorax, shown to me by Professor Prokaska, in which the whole orbicular mass of the head of the right humerus, engaged between the second and third true ribs, projected into the cavity of the chest. This singular displacement was the result of an accidental luxation, occasioned by a fall on the elbow, while the arm was extended and lifted from the side. The head of the humerus, after tearing the capsular ligament, had been violently driven into the hollow of the axilla, under the pectoral muscles, so as to separate the two corresponding ribs, and pass between them. The diameter of the head of the bone surmounted this obstacle, and penetrated entirely into the cavity of the thorax, pushing before it the adjacent portion of the pleura. Every possible effort was made in vain to reduce this extraordinary dislocation. The urgent symptoms, which arose, were dissipated by bleeding, warm bathing, and antiphlogistic remedies. The arm, however, remained at a distance from the side, to which condition the patient became gradually habituated; and, after several years of suffering and oppression, he at length experienced no inconvenience. The patient was about sixteen or seventeen, when he met with the accident; and he lived to the age of thirty-one, when he died of some disease, which had no concern with the dislocation. His physicians were anxious to ascertain the nature of this curious case, of which they had been able to form only an imperfect judgment. They were much surprised to find, upon opening the body, the head of the humerus lodged in the chest, surrounded by the pleura, and its neck closely embraced by the two ribs above specified. They were still more astonished to find, instead of a hard spherical body covered with cartilage, only a very soft membranous ball, which yielded to the slightest pressure of the finger. The cartilage and osseous texture of the whole portion of the humerus, contained within the cavity of the chest, had entirely disappeared. Of the humerus, there remained only some membranous rudiments of its head, and a great part of these seemed to belong to the pleura costalis." (*Mém. de Chir. Milit.* t. ii. p. 405—407.)

Dislocations of the Elbow.

Notwithstanding the extent of the articular surfaces of the humerus and ulna, the strength of the muscles and ligaments surrounding the joint, and the mutual reception of the bony eminences, rendering the articulation a perfect angular ginglymus, a dislocation of both the radius and ulna from the humerus, sometimes happens. The ulna is most frequently luxated backward; sometimes laterally, and very rarely forward; which last displacement cannot occur without a fracture of the olecranon. Indeed, it is so uncommon, that neither Petit nor Desault ever met with it. The luxation backwards is facilitated by the small size of the coronoid process, which, when the humerus is forcibly pushed downwards and forwards, may slip behind it, and ascend as high as the cavity, which receives the olecranon in the extended state of the fore-arm.

Sir Astley Cooper's experience has made him acquainted with five different luxations of the elbow: — 1. That of the radius and ulna backwards. 2. That of both these bones laterally. 3. That of the ulna alone. 4. That of the radius alone forwards. 5. That of the radius backwards. (*On Dislocations*, p. 467.)

In the luxation backwards, both the radius and ulna may ascend more or less behind the humerus; but the coronoid process of the ulna if not fractured, is carried above the articular pulley, and is lodged in the cavity destined to receive the olecranon. The head of the radius is placed behind and above the external condyle of the humerus. The annular ligament, which confines the superior extremity of the radius to the ulna, may be lacerated: in which case, even when the bones are reduced, it is difficult to keep them in their proper places, as the radius tends constantly to quit the ulna.

This accident takes place from a fall on the hand; for, when we are falling, we are led by a mechanical instinct to bring our hands forwards to protect the body. If, in this case, the superior extremity, instead of resting vertically on the ground be placed obliquely with the hand nearly in a state of supination, the repulsion which it receives from the ground will cause the two bones of the fore-arm to ascend behind the humerus, whilst the weight of the body pressing on the humerus, directed obliquely downwards, forces its extremity to pass down before the coronoid process of the ulna.

The fore-arm is in a state of half flexion, and every attempt to extend it produces acute pain. The situation of the olecranon, with respect to the condyles of the humerus is changed. The olecranon, which, in the natural state, is placed on a level with the external condyle, which is itself situated lower than the internal, is even higher than the latter. Posteriorly a considerable projection is formed by the ulna and radius, and on each side of the olecranon a hollow appears. A considerable hard swelling is felt on the fore part of the joint, arising from the projection of the lower end of the humerus. The hand and fore-arm are supine, and the power of bending the joint is in a great measure lost. (*Sir Astley Cooper on Dislocations*, p. 468.)

The swelling which supervenes in twenty-four hours after the accident, may obscure the diagnosis; but, notwithstanding the assertion of Boyer, I believe the olecranon and internal condyle are never so concealed, that the distance between them cannot be felt to be increased. It is true, that the friction of the coronoid process against the humerus may cause a grating noise, similar to that of a fracture; and some attention is requisite to establish the diagnosis between a fracture of the head of the radius, and a dislocation of the fore-arm backwards. "This dislocation (says Sir Astley Cooper), is at first sometimes undiscovered, in consequence of the great tumefaction, which immediately succeeds the injury; but this circumstance does not prevent the reduction, even at the period of several weeks after the accident; for, I have known it thus reduced by bending the limb over the knee, even without great violence being employed." (*On Disclocations, &c.* p. 470.)

A luxation backward must be attended with serious injury of the surounding soft parts. The lateral ligaments are constantly ruptured, and sometimes the annular ligament of the radius. In a case, dissected by Sir Astley Cooper, the annular ligament was entire. The biceps muscle was only slightly put upon the stretch; but the brachialis was excessively so. Probably the lower insertions of the biceps and brachialis internus would likewise be more frequently lacerated, by the violent protrusion of the head of the humerus forwards, were it not that their attachments are at some distance from the joint. This mischief, however, occasionally takes place. The lower end of the humerus, indeed, has been known not only to lacerate these muscles, but to burst the integuments, and present itself externally; an instance of which is recorded by Petit, and two such cases I saw during my apprenticeship at St. Bartholomew's. Boyer justly remarks, that it is difficult to conceive how, under these circumstances, the brachial artery and median nerve can escape. In fact, this vessel has sometimes been ruptured, and mortification of the limb been the consequence; but this injury of the artery, and the laceration of the muscles and skin, are rare occurrences. (*Mal. Chir.* t. iv. p. 215.) Nor, if the artery were wounded, would gangrene be invariably the result; for, if my memory is correct, an instance, in which the limb was saved, notwithstanding such a complication, used to be mentioned by Mr. Abernethy in his lectures, and I shall presently quote a similar fact from Cruveilhier.

The following method of reducing the case is advised by Boyer: — The patient being seated, an assistant is to take hold of the middle of the humerus, and make counter-extension, while another assistant makes extension at the wrist. The surgeon seated on the outside, grasps the elbow with his two hands, by applying the forefingers of each to the anterior part of the humerus, and the thumbs to the posterior, with which he presses on the olecranon, in a direction downwards and forwards. — This method will generally be successful. If the strength of the patient, or the long continuance of the luxation, render it necessary to employ a greater force, extension is to be made with a towel applied on the wrist, and a cushion is to be placed in the axilla, and the arm and trunk fixed, as is done in cases of luxation of the humerus.

In Sir Astley Cooper's method, the patient sits in a chair. The surgeon places his knee on the inner side of the elbow, in the bend of the joint; and, taking hold of the patient's wrist, bends the arm. At the same time, he presses on the radius and ulna with his knee, so as to separate them from the os humeri. Thus the coronoid process is pushed out of the posterior fossa of the humerus; and whilst the pressure is kept up with the knee, the arm is to be forcibly, but slowly, bent, and the reduction is soon effected. According to the same authority, the bones may also be reduced by bending the arm over a bedpost, or by bending it, whilst it is engaged in the opening of the back of the elbow-chair in which the patient sits. (*On Dislocations*, p. 469.)

A bandage may afterwards be applied, in the form of a figure of 8, evaporating lotions used, and the arm kept in a sling. The swelling, which follows, is to be combated by antiphlogistic means.

At the end of seven or eight days, when the inflammation has subsided, the articulation is to be gently moved, and the motion is to be increased every day, in order to prevent an anchylosis, to which there is a great tendency.

In this luxation, the annular ligament, which confines the head of the radius to the extremity of the ulna, is sometimes torn, and the radius passes in front of the ulna. In such cases, pronation and supination are difficult and painful; though the principal luxation has been reduced. The radius may be easily replaced by pressing it from before backwards, and it is to be kept in its place by a compress, applied to the superior and external part of the fore-arm. The bandage and compress are to be taken off every two or three days, and the joint gently bent and extended, in order to prevent anchylosis.

In a modern publication, an instance of a dislocation of the heads of the radius and ulna backward is related, where the lower end of the humerus protruded through the integuments, and, as it could not be reduced, it was sawn off. The patient, a boy, recovered the full use of his arm. (*Evans, Pract. Obs. on Cataract, Compound Dislocations, &c.* p. 101., 1815.)

A luxation forwards should be treated as a fracture of the olecranon, with which it would be inevitably accompanied. Here, on account of the great injury done to the soft parts, it would also be right to bleed the patient copiously, and put him on the antiphlogistic regimen.

With respect to lateral luxations, either inwards or outwards, they are always incomplete, and easily discovered. In the case outwards, the coronoid process is situated on the back part of the external condyle. The projection of the ulna backwards is even greater, than in the dislocation of both bones directly backwards, and the radius forms a protuberance behind, and on the outer side of the os humeri. By moving the hand, the rotation of the head of the radius can be distinctly felt. In the lateral dislocation inwards, the ulna may be thrown upon the internal condyle, so as to produce an apparent hollow above it, and the rotation of the head of the radius can be distinctly felt. Sometimes, when the ulna is thrown upon the internal condyle, it still projects backwards, as in the external lateral dislocation, in which circumstance, the head of the radius is in the posterior fossa of the humerus, and the outer condyle forms a considerable projection. (*Sir A. Cooper, Op.* cit. p. 471.) Boyer advises the reduction of lateral dislocations to be effected, by extending the humerus and fore-arm, and at the same time pushing the extremity of the humerus, and the heads of the ulna and radius, in opposite directions.

According to Sir Astley Cooper, in each of the lateral dislocations, the reduction may be performed, by bending the arm over the knee; but in a recent case, as one which he relates proves, he considers, that the business may be most readily accomplished by forcibly extending the arm; for when this is done, the biceps and brachialis draw the heads of the radius and ulna into their right places again. (P. 472.)

These luxations cannot be produced without considerable violence; but when the bones are reduced, they are easily kept in their place. It will be sufficient to pass a roller round the part, to put the fore-arm in a middle state, neither much bent nor extended, and to support it in a sling. But much inflammation is to be expected from the injury done to the soft parts. In order to prevent, or at least to mitigate it, the patient is to be bled and put on a low diet, leeches applied, and the articulation covered with the lotio plumbi acet. or an emollient poultice. It is scarcely necessary to repeat, that the arm is to be moved as soon as the state of the soft parts will admit of it. (*Boyer, Mal. des Os,* t. ii.)

A dislocation of the fore-arm backward is said to occur ten times as frequently as lateral luxations; and those forward are so rare, that no comparison whatever can be made. (*Œuvres Chir. de Desault,* t. i.)

All recent dislocations of the elbow are easily reduced, and as easily maintained so; for a displacement is prevented by the reciprocal manner in which the articular surfaces receive each other, and by their mutual eminences and cavities. This consideration, however, should not lead us to omit the application of a bandage in the form of a figure of 8, and supporting the arm in a sling.

Cruveilhier has published an engraving of the changes, which followed an unreduced dislocation of the elbow. The case is a dislocation of the bones of the fore-arm from the humerus backward. The head of the radius and the olecranon project behind the lower end of the humerus, which bone is maintained in the bent position by deposits of osseous matter, which extend in a pointed form to a considerable height. Extension and flexion of the elbow are both equally impossible; motion is restricted to a slight yielding, allowed by some disproportion between the lower end of the humerus and the capacity of the osseous shell. The new bony formation arises from the radius and ulna, uniting them solidly together, embracing the lower end of the humerus to which it moulds itself, and ascending an inch and a half above the end of the humerus. There are several perforations, or deficiencies in it, through which the humerus is perceptible. The coronoid process of the ulna, which is blunted, is lodged in the fossa behind the humerus. "The case proves (says M. Cruveilhier) that, in the dislocation of the fore-arm from the humerus backward, the displacement backward is limited by the coronoid process meeting with the olecranal fossa of the humerus; that there must be a more or less considerable laceration of the brachialis muscle; and that the tendon of the biceps must generally remain entire, and make a tense chord, constituting a limit to the displacement forwards. If the violence occasioning a dislocation backwards, should be carried farther, not only may there be laceration of the brachialis, but also of the tendon of the biceps, the brachial artery, the veins, the median nerve, and even the skin, attended with protrusion of the bone. I have seen a case of this kind, in a lady who was thrown from her horse, and fell on the palm of her hand. When I arrived, a profuse hemorrhage from the artery had just ceased, in consequence of syncope. The dislocation having been reduced, I kept myself ready to secure the artery, but the bleeding did not return." The case terminated favourably. (See *Cruveilhier, Anat. Pathol.* livr. ix. ch. iv. p. 8.)

Dislocation of the Radius from the Ulna.

The majority of writers on dislocations of the fore-arm have not separately considered those of the radius. The subject was first well treated of by Duverney. However, dislocations of its lower end remained unnoticed, until Desault favoured the profession with a particular account of them.

The radius, the moveable agent of pronation and supination, rolls round the ulna, which forms its support, by means of two articular surfaces; one above, slightly convex, broad internally, narrow outwardly, and corresponding to the little sigmoid cavity of the ulna, in which it is lodged; the other below, concave, semicircular, and adapted to receive the convex edge of the ulna. Hence, there are two joints, differing in their motions, articular surfaces, and ligaments.

Above, the radius in pronation and supination only moves on its own axis; below, it rolls round the axis of the ulna. Here, being more distant from the centre, its motions must be both more extensive and powerful, than they are above. The head of the radius, turning on its own axis in the annular or coronary ligament, cannot distend it in any direction. On the contrary, below, the radius, in performing pronation, stretches the posterior part of the capsule, and presses it against the immoveable head of the ulna, which is apt to be pushed through, if the motion be forced. A similar event, in a contrary direction, takes place in supination. The front part of the capsule being rendered tense, may now be lacerated.

Add to this disposition, the difference of strength between the ligaments of the two joints. Delicate and yielding below, thick and firm above, their difference is very great. The upper head of the radius, supported on the smaller immoveable articular surface of the ulna, is protected from dislocation in most of its motions. On the contrary, its lower end, carrying along with it, in its motions, the bones of the carpus, which it supports, cannot itself derive any solid stability from them.

Some instances of dislocation of the upper head of the radius suddenly produced by external causes, are recorded by Duverney; and the particulars of another were transmitted to the French Academy of Surgery.

Examples have also occurred in the practice of Mr. Dunn, of Scarborough; Mr. Lawrence; and Mr. Earle. Sir Astley Cooper has seen six examples of the dislocation of the head of the radius forwards. Boyer says, that many instances are now known, in which the upper head of the radius was dislocated backwards; indeed, in opposition to what Desault has stated, he correctly asserts that dislocations of the lower joint between the radius and ulna are more rare, than those of the upper joint. The latter accident he had twice seen. (*Mal. Chir.* t. iv. p. 248.) Two other examples have been recently published by Mr. Collier, of Brackley. (See *Lond. Med. Gaz.* vol. xviii. p. 918.) In December 1830, I attended a boy about fifteen years of age, who fell down in attempting to leap over a post with his hands placed upon it, and forced the head of the radius upon the outside of the external condyle of the humerus.

Into the North London Hospital, a lad was admitted in 1836, the upper head of whose radius had been thrown considerably above the external condyle for some years; and the motions of whose elbow were but little impaired by the accident. I have also seen two or three instances in children of dislocations of the upper head of the radius from weakness, or relaxation of the annular ligament.

The displacement backwards is described as occurring more frequently in children, than adults. The reason of this circumstance is ascribed to the lesser firmness both of the ligaments and of the tendinous fibres of the extensor muscles, which fibres, in a more advanced age, contribute greatly to strengthen the external lateral ligament. In a child, also, the little sigmoid cavity of the ulna is smaller, and the annular ligament, extending round the head of the radius, is longer, and more apt to give way. Hence in a subject of this description, efforts, which may not at first produce a dislocation, if frequently repeated, cause a gradual elongation of the ligaments, a change in the natural position of the bones, and, at length, a degree of displacement as great as in a case of luxation, suddenly and immediately effected. (*Mal. Chir.* t. iv. p. 239.)

Another fact, mentioned by Boyer, is, that the dislocation of the upper head of the radius backwards is always complete, its articular surfaces being perfectly separated both from the lower end of the humerus, and from the little sigmoid cavity of the ulna. The usual cause of the accident is a pronation of the fore-arm, carried with great violence beyond the natural limits.

In a dislocation of the head of the radius backwards, the fore-arm is bent, and the hand fixed in the state of pronation. Supination can neither be performed by the action of the muscles, nor by external force; and every attempt to execute this movement produces a considerable increase of pain. The hand and fingers are moderately bent, and the upper head of the radius may be observed forming a considerable projection behind the external condyle of the humerus. In the case, which was mentioned to me by Mr. Lawrence, and in that which I attended in December 1830, the head of the radius lay upon the outside of the external condyle.

Sir Astley Cooper has never seen a dislocation of the upper head of the radius backwards in the living subject; but a man was brought for dissection into the theatre of St. Thomas's Hospital, who had such a dislocation, which had never been reduced. The head of the radius was thrown behind the external condyle, and rather to the outer side of the lower extremity of the humerus. The fore part of the coronary ligament was torn through, as well as the oblique one, and the capsular was partially lacerated.

The reduction is to be accomplished, by extending the fore-arm and endeavouring to bring it into the supine posture, at the same time, that the surgeon tries to press with his thumb the head of the radius forwards, towards the lesser tubercle of the humerus, and into the little sigmoid cavity of the ulna again. Success is indicated by the patient being now able to perform the supine motion of the hand, and to bend and extend the elbow with freedom.

For the purpose of preventing a return of the displacement, and giving nature an opportunity of repairing the torn ligaments, measures must be taken to hinder the pronation of the hand. Boyer recommends, with this view, a roller, compresses, and a sling; but, it appears to me, that a splint, extending nearly to the extremity of the fingers, and laid along the inside of the fore-arm, with a pad of sufficient thickness to keep the hand duly supine, would be right, in addition to the sling, roller, &c.

As facts of pathological anatomy relating to this dislocation, Cruveilhier informs us, that he is acquainted with only the two cases, of which Sandifort has given engravings. (*Museum Anat.* ch. 103.) In both instances the head of the radius is luxated backward, and the radius and ulna cross at their upper part, as in extreme pronation, and are there anchylosed to one another. In one of these examples the head of the radius is diminished; the lesser articular surface of the humerus has disappeared, and been confounded with the trochlea, so as to correspond to the enlargement of the greater cavity of the ulna. The connection of the radius to the sigmoid cavity of the ulna extends a good way along the inner side of the coronoid process and front surface of the ulna. Directly below this connection, the radius is increased in size, and is much deformed. In consequence also of the lower end of the ulna having lost its relations to the corresponding cavity of the radius, it no longer exists. In the second example, the radius and ulna, where they cross, are soldered together; and the lower end of the ulna is considerably deformed, and its head converted into a mere tubercle; while the head of the radius, which is displaced outwards and backwards, is divided into two parts; one, still corresponding to the lesser articular surface of the humerus; the other not touching that surface except in extreme flexion of the joint.

Cruveilhier refers to a case reported in the Journ. *Hebdom. de Méd.* as a *congenital dislocation of the upper head of the radius in each arm*, and also allusion is made by M. Paillard to another instance of the same kind, which was met with many years ago by Dupuytren. Cruveilhier does not concur in regarding these cases as congenital; and adverts to the frequency of incomplete displacements of the head of the upper radius backwards in young children, owing to the imperfect development of the lesser sigmoid of the ulna, the consequent looseness of the annular ligament, and the frequently forcible pronation of their hand, when held by it to keep such young subjects from falling. In Cruveilhier's Livraison ix. pl. 3. are given representations of an old unreduced dislocation of the head of the radius, which lies behind and to the outer side of the lower end of the humerus, and is lodged in a little cup of a fibrous structure, formed, as Cruveilhier suspects, at the expense of the anconæus, and its aponeurosis, or else of the remains of the external lateral and annular ligaments. The head of the radius has undergone a change of shape, and become convex and oblong. The neck is slender, and projected outwards, and the tubercle very diminutive.

Fig. 4. of the same plate illustrates the pathology of another unreduced dislocation of the upper head of the radius backwards, which, as well as in the foregoing example, lies on the same level as the apex of the olecranon, in consequence of an elongation of the head and neck of the bone, and not of its ascent. The tubercle of the radius, which is nearly effaced, and the insertion of the biceps, are on a level with the coronoid process of the ulna. There is a little cup of fibrous structure for the head of the bone, which last part has a thin investment of cartilage. The lesser sigmoid cavity of the ulna is obliterated. (See *Cruveilhier*, *Anat. Pathol. Livr.* ix. Pl. 3., *Fol. Paris* 1829—1832.)

In the dislocation of the head of the radius forwards, this part is thrown into the hollow above the external condyle, and upon the coronoid process of the ulna. According to Sir Astley Cooper, the fore-arm is slightly bent, but cannot be bent to a right angle, nor completely extended. When it is suddenly bent, the head of the radius strikes against the fore part of the os humeri. The hand is in the prone position, and, if rotated, the corresponding motion of the head of the radius can be felt at the upper and front part of the elbow joint. The coronary or annular, the oblique ligament, the front of the capsular, and a portion of the interosseous ligament, are torn.

Sir Astley Cooper refers the cause of this accident to a fall upon the hand, when the arm is extended; in which event, the radius receives the weight of the body, and is forced up by the side of the ulna, and thrown over the external condyle upon the coronoid process. In two of the cases recorded by him, the reduction could not be accomplished; in the third, it was effected during a syncope, by extending the fore-arm, while the olecranon rested on Sir Astley's foot. In the fourth, the patient was placed on a sofa, and his arm bent over the back of it, in which state, extension was made from the hand, *without including the ulna*. The sofa fixed the os humeri, and the reduction was accomplished in a few minutes. The chief things to be observed are, to let the extension act upon the radius alone, without the ulna, and during the extension to let the hand be supine. (*Dislocations*, p. 474—477.) In the latter posture, the fore-arm should also be kept by means of a splint, pad, and bandage, until the torn parts are healed.

Dislocation of the lower End of the Ulna.

Desault gives the case of a laundress, who dislocated the lower end of the ulna backwards, by a powerful pronation of her hand in twisting a wet sheet. (*Boyer, Mal. Chir.* t. iv. p. 249.) Another case, much more rarely met with, is that in which the lower extremity of the ulna is dislocated forwards; for in the course of a long experience, Dupuytren had seen but two instances of it. One happened to an officer of the *gendarmerie*, whose horse fell with him, and the right fore-arm was injured between the horse's head and the ground. On presenting himself at the Hôtel-Dieu, about thirty-four hours after the accident, the fore-arm appeared very much swoln; the hand was in the midstate between pronation and supination; there was an unusual projection of the skin at the middle of the front of the wrist, while, at its inner part, the styloid process was not perceptible; and behind, instead of the customary prominence, formed by the head of the ulna, there was a depression. When the ulna was traced from the elbow to the hand, the direction of it was felt to be forwards and outwards, crossing over and above the lower end of the radius. As the latter bone continued free from displacement, the carpus did not project either backwards or forwards. No crepitus was distinguishable, and the prone and supine movements of the hand were entirely obstructed. (*Dupuytren, Clin. Chir* t. iv. p. 503—506.) Sir Astley Cooper has not recorded any example of this rare dislocation of the end of the ulna forwards, which never presented itself to Desault but once, and that was in the dead body of a man, both of whose arms were dislocated, and of whom no particulars could be learnt. The end of the ulna was placed in front of the sigmoid cavity of the radius, and in contact with the os pisiforme, to which it was connected by a capsular ligament. (*Boyer, Mal. Chir.* t. iv. p. 249.) The latter writer has also recorded one instance of the accident. (Vol. cit. p. 253.)

The luxations of the lower head of the radius, described by Desault, are the same as those named by Sir Astley Cooper and Dupuytren dislocations of the lower end of the ulna from the radius; and differ from a luxation of the radius at the wrist, inasmuch as the hand is not thrown in the opposite direction to that of the radius, which bone is merely displaced from the convex articular surface of the ulna, the hand going along with it. This circumstance makes a material difference in the mode of reduction, with reference to the direction in which the hand is to be pushed. In the luxation of the lower end of the ulna backward the symptoms are, constant pronation of the fore-arm; an inability to perform supination, and great pain on its being attempted; an unusual projection at the back of the joint, in consequence of the protrusion of the little head of the ulna through the capsule; the position of the radius is more forward than natural; constant adduction of the thumb, which is almost always extended, and a half bent state of the fore-arm.

When the dislocation is forward, an assistant is to take hold of the elbow, and raise the arm a little from the body; while another is to support the hand and fingers.

The surgeon is to take hold of the end of the fore-arm with both his hands; one applied to the inside, the other to the outside, in such a manner, that the two thumbs meet each other in front of the limb, between the ulna and radius, while the fingers are applied to the back of the wrist. He is then to endeavour to separate the two bones from each other, pushing the radius backward and outward, while the ulna is held in its proper place. At the same time, the assistant, holding the hand, should try to bring it into a state of supination and consequently the radius, which is its support. Thus pushed, in the direction contrary to that of the dislocation, by two powers, the radius is moved outward, and the ulna returns into the opening of the capsule, and into the sigmoid cavity.

Sir A. Cooper reduces a dislocation of the lower end of the ulna backward, by pressing the bone forwards, and maintains the reduction with splints, well padded, and a compress of leather over the end of the ulna. (*On Dislocations*, p. 505.)

If chance should present a dislocation of the lower end of the ulna forwards, the same proceedings, executed in the opposite direction, would accomplish the reduction. (See *Œuvres Chir. de Desault*, t. i.)

In one example of this very rare accident, which was under Dupuytren, counter-extension with the elbow bent to a right angle over a folded cloth, and extension, made from the wrist itself, failed to reduce the bone; but, as soon as Dupuytren made extension, from the hand and pressed this part strongly outwards, while, with both his thumbs, he propelled the ulna inwards and backwards, the reduction was effected. (*Dupuytren, Clin. Chir.* t. iv. p. 507.)

A protrusion of the small end of the ulna through the skin forwards must be excessively rare, owing to the strength of the ligaments, and the thickness of the integuments themselves, in this direction; but, in the dislocation backwards, the ligaments make less resistance, and the skin is almost close to the bone, so that, in this case, the protrusion is more likely to happen. If the dislocation were compound, ought the end of the bone to be sawn off, or amputation performed? Dupuytren is in favour of immediately reducing the end of the ulna, and making free incisions for the relief of the tension and strangulation likely to ensue. He would not saw off the end of the ulna — much less would he amputate. (*Clin. Chir.* t. iv. p. 510.) The free incisions, I think, would be early enough when the confinement of the inflamed parts by the fascia had actually come on, and threatened mischievous consequences.

Cruveilhier gives an engraving of a fore-arm, in which the radio-carpal articulation had been dislocated by the force of the contraction of the cicatrix of an extensive burn. The end of the radius was in front of the carpal bones. (See *Anat. Pathol. Mal. des Articulations*, Fol. Paris, 1829. — 1832.) This example, however, does not affect the general accuracy of Dupuytren's observations, with regard to the excessive rarity of dislocation of this joint by external violence.

Dislocations of the Wrist.

The carpal bones are usually described as being capable of being luxated from the lower end of the radius forwards or backwards, inwards or outwards. The case backwards, which has been stated to be the most frequent, is facilitated by the direction of the convex articular surfaces of the scaphoid, lunar, and cuneiform bones, which slope more backwards than forwards. According to Sir Astley Cooper, the direction of the force determines the direction in which the carpal bones are thrown: thus, if a person, in falling, put out his hand to save himself, and fall upon the palm, a dislocation may happen, the radius and ulna being forced forwards upon the annular ligament, and the carpal bones thrown backwards. A considerable swelling is produced by the radius and ulna on the fore part of the wrist, and a similar protuberance upon the back of the wrist by the carpus, with a depression above it, and the hand is bent back. When the carpal bones are dislocated forwards under the flexor tendons, and the radius and ulna backwards upon the posterior part of the carpus, the accident has been caused by a fall on the back of the hand. In each of these cases, two swellings are produced; one by the radius and ulna; the other, by the bones of the carpus. Sprains will often cause a great swelling over the flexor tendons, and give rise to the suspicion of a luxation, from which they may be known by the swelling being single, and its not having made its appearance directly after the injury.

Notwithstanding these statements, respecting dislocations of the wrist, Dupuytren invariably found, that these pretended accidents always turned out to be fractures of the radius near the articulation; and he was of opinion, that there is not a single unequivocal instance on record of a dislocation of the radio-carpal articulation. He had dissected numerous wrists, but never observed a luxation of them from a fall on the palm. The only cases, which he met with, were consequent to diseases of the articulation, or symptomatic of other lesions. (*Clin. Chir.* t. iv. p. 162.) Dupuytren quotes the following lines from a memoir on fractures of the fore-arm by Pouteau:—"*Ces fractures sont le plus souvent prises pour des entorses, pour des luxations incomplètes, ou pour un écartement ou du cubitus, ou du radius à leur jonction vers le poignet.*" Desault likewise, in noticing fractures of the lower end of the radius, adverts to their having sometimes been mistaken for dislocations:—"At the present time (says Dupuytren) there can be no doubt about the frequency of fractures of the lower end of the radius, and about the impossibility, or at all events, the extreme rarity of dislocations." This celebrated surgeon dwells upon a variety of anatomical circumstances, which seem to account for the rarity of the latter kind of accident; and explains how in a fall upon the hand or front of the wrist, the force acts upon the radius, and is very likely to break its lower end, which, though thick, is of a soft spongy structure. The resistance to the dislocation forwards, made by the several flexor tendons, which pass under the annular ligament is also taken into the account. So considerable is the total resistance, when the wrist is very much extended, that Dupuytren was convinced, that a force of 2000 pounds would not overcome it. As for a dislocation backwards from a fall on the back of the hand, Dupuytren conceived, that there was effectual resistance made to its occurrence by the extensor tendons. So strong were Dupuytren's doubts of the possibility of a dislocation of the lower end of the radius forwards, that he was induced to examine very carefully the only case of it recorded with any details in modern times, namely that published by Professor Cruveilhier. (*Anat. Pathol. Mal. des Articulations.*) The subject was an adult female, about whom no information could be obtained. The fore-arm seemed shorter, than natural; the lower ends of the radius and ulna formed a considerable prominence under the skin; but the radius projected less than the ulna, and did not descend so far. The upper extremity of the carpus was on a plane superior and anterior to that of the lower extremity of the bones of the fore-arm. The hand formed a right angle with the fore-arm, and inclined towards the radial side. Extension was impossible; but flexion could be carried much beyond a right angle. In the dissection, Cruveilhier found all the muscles of the arm in a state of atrophy, and especially, the radial and ulnar extensors and flexors, and the pronators and supinators. The upper row of carpal bones were remarkably altered in shape, and, with the exception of the pisiform bone, reduced in size by one-half. The second row was likewise altered, and, indeed, of the great and unciform bones the mere rudiments remained; while the upper part of the trapezium and trapezoid bones, which should correspond to the scaphoid, was diminished. The ulna, but slightly altered in shape, reached five or six lines beyond the lower end of the radius. The radius was shortened and deformed, principally at its lower end, which was large and irregular, and grooved on its posterior surface for the lodgment of the extensor muscles. From these and some other particulars, M. Cruveilhier concluded, that the accident had been a dislocation of the bones of the fore-arm backwards, or of the carpus forwards. On the contrary, Dupuytren suspected, that the case had been a fracture, which, from the atrophy of the carpal bones, had probably taken place in infancy. Amongst other considerations, which influenced Dupuytren in regarding the case as a fracture, was the shortened state of the radius; while the ulna, which was also luxated, and even less active than it, was half an inch longer than it. On the presumption of the case being a fracture, or a detachment of the epiphysis, every thing is readily explicable. The epiphysis of the radius was believed by Dupuytren to have been separated by a fall on the back of the hand, and the violence seemed to him to have thrown it with the carpus and hand forwards. The union of the epiphysis to the bone appeared to him to account for the unusual process, which supports the new articulation; and the ulna itself really dislocated, was longer than the radius, which, besides being broken, had been shortened by the displacement of the fragments. According to M. Malgaigne, the shortening of the radius, on the supposition of the case being a dislocation, was inexplicable.

Many years ago, a bricklayer was taken to the Hôtel-Dieu with several dangerous injuries received in a fall. His skull was fractured, and there was a good deal of deformity about the wrist. Some surgeons thought that there was a dislocation of the carpus backwards. On the contrary, Dupuytren pronounced the case to be a fracture of the inferior part of the fore-arm. The patient having died of the consequences of the injury of the head, the correctness of Dupuytren's diagnosis was verified in the *post mortem* examination. M. Marjolin was mistaken in a similar case, as was likewise proved by dissection.

Another source of occasional deception is a particular conformation of the wrist in certain classes of workmen, whose employments lead them to make sudden, violent, and repeated extensions. In consequence of these efforts, the ligaments of the wrist not unfrequently become relaxed, so as to allow the bones to move more extensively than in the natural state. The carpus, being then not firmly fixed to the fore-arm, yields to the action of the flexor muscles, and becomes displaced in front of the lower ends of the radius and ulna. Deformity, and some degree of weakness are the only inconveniences of this state of the wrist, which rarely obliges the individuals to discontinue work. (See *Dict. des Sciences Med.*) When a fracture of the lower end of the radius is mistaken for a dislocation, or neglected, the interosseous space becomes effaced; the fore-arm, instead of its proper flat form in this situation, acquires a cylindrical shape; and the movements of pronation and supination are destroyed. (*Dupuytren, Clin. Chir.* t. iv. p. 211.) I have seen two cases, within a recent period, where the epiphysis of the lower end of the radius was separated from the rest of the bone by a fall. Both the patients were boys, who had sustained other severe injuries. One died in the North London Hospital; and the joint, having been dissected, is preserved in University College museum.

If a dislocation of the radio-carpal joint were to be met with, gentle extension and counter-extension would be requisite, while the two surfaces of the joint should be made to slide on each other in a direction contrary to what they took when the accident occurred.

Dislocation of the Carpus, Metacarpus, Fingers, and Thumb.

A simple dislocation of the carpal bones from each other seems almost impossible. The os magnum, however, is sometimes partially luxated from the deep cavity formed for it in the os scaphoides and os lunare. This displacement is produced by too great a flexion of the bones of the first phalanx on those of the second, and the os magnum forms a tumour on the back of the hand. (*Chopart, Boyer, Richerand.*) Chopart once met with a partial luxation of the os magnum. Boyer had seen several examples of the accident, which, he says, is more common in women than men; a circumstance which he imputes to the ligaments being looser in females, and to the bones of the carpus in them having naturally a greater degree of motion. The tumour increases, when the hand is bent, and diminishes, when it is extended. The case does not produce any serious inconvenience. If the wrist be extended, and pressure be made on the head of the os magnum, the reduction is easily accomplished; though a renewal of the displacement cannot be prevented, unless the extension and compression be kept up by means of a suitable apparatus, during the whole time requisite for the healing of the torn ligaments. As the inconveniences of the accident are slight, few patients will submit to any tedious, irksome treatment; and sometimes the surgeon is never consulted, till it is too late to think of replacing the bone.

Sir Astley Cooper has seen two cases of displacement of the os magnum in females; the accidents produced a weakness of the hand, and arose from relaxation of the ligaments. One example is also given of a dislocation of the os scaphoides, which was thrown backward upon the carpus, with the lower portion of the broken radius. (*On Dislocations*, p. 514, 515.) Compound dislocations of the carpal bones generally arise from gunshot violence, or other great mechanical injury. In these cases, it is sometimes necessary to take away the displaced bones altogether; and, too frequently, the accident is complicated with so much additional mischief, as to require amputation.

The connection of the metacarpal bones with one another, and with those of the carpus, is so close, and the degree of motion so slight, that a dislocation can hardly take place. Thus, Sir Astley Cooper, in his vast experience, has never seen them dislocated, except by the bursting of guns, or by the passage of heavy carriages over the hand; cases frequently demanding amputation. (*On Dislocations*, p. 519.) The first metacarpal bone, which is articulated with the os trapezium, and admits of the movements of flexion, extension, abduction, and adduction, is capable of being luxated; but the accident is uncommon. Although, from the nature of the joint, between the first metacarpal bone and the trapezium, one might infer, that a dislocation is possible in four directions, some of these varieties must be very rare. The dislocation backwards is produced by the application of external force to the back of the metacarpal bone, which is violently bent, the case usually arising from a fall on the outer edge of the hand. The capsular ligament is lacerated, the extensor tendons of the thumb are pushed up, and the head of the bone slips behind the trapezium.

In the cases, which Sir Astley Cooper has seen, the metacarpal bone was thrown inwards, between the trapezium and the root of the metacarpal bone of the fore-finger, so as to form a protuberance towards the palm; the thumb was extended backwards, and it could not be brought towards the little finger. Considerable pain and swelling followed the accident. In the reduction, Sir Astley Cooper deems it best to make extension with the thumb inclined towards the palm, in order to lessen the resistance of the flexor muscles. Steady extension must be unremittingly kept up; and, if the reduction cannot be accomplished in this way, the same experienced surgeon considers it advisable "to leave the case to the degree of recovery, which nature will in time produce, rather than divide the muscles, or run any risk of injuring the nerves and blood-vessels." In a compound dislocation, produced by the bursting of a gun, the bone is to be reduced, the integuments brought together, and the part poulticed. When the muscles are severely torn, amputation of the thumb may be necessary, in which case Sir Astley Cooper recommends the removal of the articular surface of the trapezium with a saw. (*On Dislocations*, p. 488. ed. 4.) The cutting pliers would perhaps answer better.

The first phalanges of the fingers may be dislocated backwards off the heads of the metacarpal bones. A luxation forwards would be difficult; because the articular surfaces of the metacarpal bones extend a good way forwards, and the palm of the hand makes resistance to such an accident. According to Sir Astley Cooper, dislocation of the fingers more frequently happens between the first and second phalanges, than between the second and third; the second being thrown forward, towards the theca, and the first backwards. The reduction is effected by making extension with a slight inclination forward, so as to relax the flexor muscles. When reduction is impracticable by common means, or from the oldness of the dislocation, Sir Astley Cooper disapproves of the scheme of dividing the ligaments, in order to succeed. The mischief, which he has known arise from injuries of tendons and ligaments, deters him from advocating the practice. (*On Dislocations*, p. 485, 486. ed. 4.)

The first phalanx of the thumb is often dislocated backwards, behind the head of the first metacarpal bone, in which case it forms a projection backwards, and remains extended, while the second phalanx is bent. The motion of this joint is lost, but that between the metacarpal bone and the os trapezium continues free.

This dislocation should be speedily reduced; for, after eight or ten days, it becomes irreducible. Sir Astley Cooper recommends the extension to be made, while the thumb is bent towards the palm, and the flexor muscles relaxed; and the following is his method of applying the extending force, which he adopts also for dislocations of the toes, thumb, and fingers in general: — "The hand is to be first steeped in warm water, for a considerable time, to relax the parts, as much as possible. Then a piece of thin wetted leather, (wash leather for instance), is to be put around the first phalanx, and as closely adapted to the thumb as possible. A portion of tape, about two yards in length, is then to be applied upon the surface of the leather in the knot, which is called by the sailors, the *clove-hitch*, for this becomes tighter as the extension proceeds. An assistant places his middle and fore-finger between the thumb and fore-finger of the patient, and makes the counter-extension, whilst the surgeon, assisted by others, draws the first phalanx from the metacarpal bone, directing it a little inwards, towards the palm of the hand. The extension should be supported for a considerable length of time, and if success does not attend the surgeon's efforts, it is right to adopt the following plan: — The leather and sailor's knot are to be applied as before directed, and a strong worsted tape is to be carried between the metacarpal bone of the thumb and the fore-finger. The arm is then to be bent around a bed-post, and the worsted tape fixed to it. A pulley is then to be hooked to the tape, which surrounds the first phalanx, and extension is to be made. This mode is almost sure to succeed." (*Sir A. Cooper*, *Op.* cit. p. 493. ed. 4.) In a luxation of the first bone of the thumb, which was too old to be easily reduced, and where the part was thrown behind the head of the metacarpal bone, Desault proposed cutting down to the dislocation, and pushing the head of the bone into its place with a spatula. Even in cases, which are quite recent, this kind of dislocation sometimes cannot be reduced without the utmost difficulty; and the different proposals which have been made, respecting this particular accident, by Mr. Evans, the late Mr. Hey, Sir C. Bell, and Boyer, deserve the notice of the surgical practitioner. On this subject, however, Sir Astley Cooper remarks, that he has seen too much mischief arise from injury to the tendons and ligaments, ever to recommend their division, in order to facilitate the reduction, when extension will not succeed. (*On Dislocations*, p. 523.) Dislocations of the thumb and little finger inwards, and that of the thumb outwards (which are possible cases), and luxations of the first phalanges of the other fingers backwards, and of their second phalanges forwards, are all reduced by making extension on the lower end of the affected thumb, or finger, and at the same time pressing the head of the bone towards its natural situation.

Dislocations of the Bones of the Pelvis.

Experience proves, that the bones of the pelvis, notwithstanding the vast strength of their ligaments, may be dislocated by violence : thus, the os sacrum may be driven forwards towards the interior of the pelvis; the ossa ilium may be displaced forwards and upwards; and the bones of the pubes may be totally separated at the symphysis, and an evident degree of moveableness occur between them. For the production of these accidents, however, the operation of enormous force is requisite; and, in fact, their usual causes are falls from a great height; the fall of a very heavy body against the sacrum, at a period when the body is fixed; and the pressure of the pelvis between a wall, or post, and the wheel of a carriage, or waggon. Hence, the dislocation is generally the least part of the mischief occasioned by such kinds of violence, and the case is often attended with concussion of the spinal marrow, injury of the sacral nerves, extravasation of blood in the cellular substance of the pelvis or cavity of the peritoneum, injury of the kidneys, and fracture of one or more of the bones of the pelvis. Sir A. Cooper has remarked, that some of these cases, complicated with fracture, are liable to be mistaken for dislocations of the thigh: — "When a fracture of the os innominatum happens through the acetabulum, the head of the femur is drawn upwards, and the trochanter somewhat forwards, so that the leg is shortened, and the knee and foot is turned inwards. Such a case, therefore, may be readily mistaken. If the os innominatum is disjointed from the sacrum, and the pubes and ischium are broken, the limb is slightly shorter than the other; but the knee and foot are not turned inwards. These accidents may generally be detected by a crepitus perceived in the motion of the thigh, when the surgeon applies his hand to the crista of the ilium, and there is greater motion, than in a dislocation of the thigh." (*Surgical Essays*, part i. p. 49.) In a subsequent article, I shall notice Mr. Earle's observations on this subject. See Fracture.

In addition to the complications, which may attend a dislocation of the bones of the pelvis, and arise immediately from the external violence, the case is always followed by inflammation, the consequences of which may be very serious, not only on account of the extent of the articular surfaces affected, but because such inflammation may extend to the peritoneum, and viscera of the abdomen and pelvis, of which I have myself seen instances.

Louis relates a case, in which the os ilium of the right side was separated from the sacrum, so as to project nearly three inches behind it. The accident was caused by a heavy sack of wheat falling on a labourer. (*Mém. de l'Acad. de Chir.* t. iv. 4to.)

In a case, recorded by Sir A. Cooper, the posterior part of the acetabulum was broken off, and the head of the thigh-bone had slipped from its socket; the fracture extended across the os innominatum to the pubes, the bones of which were separated at the symphysis nearly an inch asunder. The ilia were separated on each side, and the left os pubis, ischium, and ilium broken. (*Surgical Essays*, part i. p. 50.) In the same work may be perused another case of fracture of the body of the os pubis and ramus of the ischium, combined with a luxation of the right os innominatum from the sacrum, and laceration of the ligaments of the symphysis of the pubes.

When these cases do not prove fatal from the direct effect of the great violence committed on many parts, or from peritonitis, the same unpleasant event sometimes follows rather later from suppuration of the articular surfaces taking place, and abscesses forming in the cellular tissue of the pelvis. (*Boyer, Mal. Chir.* t. iv. p. 147.)

A case, in which a dislocation of the left os innominatum upwards had a successful termination, was attended by Enaux, Hoin, and Chaussier, and is published in a modern work. (*Mém. de l'Acad. des Sciences de Dijon.*) As the reduction could not be accomplished at first, antiphlogistic treatment was followed for some days, when new attempts to replace the bone were made, but could not be continued, as they caused a recurrence of pain and other bad symptoms. A third trial, made at a later period, was not more effectual; and all thoughts of reduction were then abandoned. After the patient had been kept quiet some time, though not so long as was wished, he quitted his bed, and began to walk about on crutches. I do not understand, however, as is asserted, how the weight of the body could now bring about the reduction, which had been previously attempted in vain. Be this as it may, the result was the patient's recovery. The fact clearly proves, as Boyer observes, that, in cases of this description, the most important object is not to aim at the reduction, but rather to oppose, by every means in our power, inflammation and its consequences. Frequently, the use of the catheter is necessary, and, sometimes an incontinence of urine, or the involuntary discharge of the feces, demands the strictest attention to cleanliness. In these cases, if the patient live any time, there is also another source of danger, consisting in a tendency to sloughing in the soft parts, on which the patient lies, and which, when they have been bruised, require still greater vigilance.

The os coccygis is not so easily dislocated as fractured. Boyer had seen it displaced in a man, who had extensive ulcerations, by which it was laid bare. There was an interspace of nearly two inches, between the sacrum and base of the os coccygis. In proportion as the man regained his strength, the bone recovered its right position, and at length united to the os sacrum, notwithstanding the action of the levatores ani, which are inserted into it. This case, however, was not an accidental luxation; but arose from the destruction of the ligaments by disease.

Authors mention two kinds of dislocation, to which the os coccygis is liable; one, inward; the other, outward. The first is always occasioned by external violence; the second, by the pressure of the child's head in difficult labours. Pain, difficulty of voiding the feces and urine, tenesmus and inflammation, sometimes ending in abscesses, which interest the rectum, are symptoms, said to follow such dislocations.

All schemes for the reduction are useless, as the bone will spontaneously return into its place as soon as the cause of displacement ceases; and the introduction of the finger within the rectum, and handling of the painful and injured parts, are more likely to increase the subsequent inflammation, and produce abscesses, than have any beneficial effect. The wisest plan is to be content with enjoining quietude, and adopting antiphlogistic measures.

Dislocation of the Ribs.

J. L. Petit believed such a case never occurred. Buttet related an instance, which he supposed to be a dislocation of the posterior extremity of the rib from the vertebræ; but Boyer clearly proved, that no true reasons existed for this opinion, and that the case was only a fracture of the bone, near the spine. (*Mal. Chir.* t. iv. p. 123.) Paré, Barbette, Juncker, Platner, and Heister, not only admit the occurrence of luxations of the ribs, but describe different species of them. Lieutaud extended the term luxations to cases, in which the head of the rib is separated by disease, the pressure of aneurisms, &c.

In a modern work may be read the particulars of a case, where all the ribs were dislocated from their cartilages, in consequence of the chest being violently compressed between the beam of a mill and the wall. In such a case there is no means of reduction, except the effect produced by forcible inspirations; nor are there any modes of relief, but bleeding, and the application of a roller round the chest. (See *C. Bell's Surg. Obs.* p. 171.)

Dislocations of the Thigh-Bone.

The head of the thigh-bone may be dislocated upwards on the dorsum of the ilium; upwards and forwards, on the body of the os pubis; downwards and forwards, on the foramen ovale; backwards, on the ischiatic notch; and, on very rare occasions, behind the tuberosity of the ischium. The dislocation upwards, and that downwards and forwards, are the most frequent.

The *dislocation upwards, on the dorsum of the ilium*, is attended with the following symptoms:— The limb is from one inch and a half to two inches and a half shorter than its fellow, the thigh a little bent, and carried inwards. The knee inclines more forwards and inwards than the opposite one; the leg and thigh are turned inwards, and the foot points in this direction; the toe resting, as Sir A. Cooper remarks, against the tarsus of the other foot. (*Surgical Essays*, part iv. p. 27.) There is an approximation of the trochanter major to the anterior superior spinous process of the ilium; and, at the same time, it is elevated and carried a little forwards. It is also less prominent, than that on the opposite side, and the natural roundness of the hip has disappeared. The natural length of the limb cannot be restored, without reducing the luxation; the foot cannot be turned outwards, without great difficulty, and any attempt to do so causes pain; but, the inclination of the foot inwards may be increased. Thus, in Dr. Scott's case, "Every attempt at rotation outwardly caused extreme pain in the groin, at the hip, and in the course of the sciatic nerve. When, however, with difficulty and much suffering to the patient, a certain degree of rotation was effected, the trochanter described a segment of a large circle." (See *Dublin Hospital Reports*, vol. iii. p. 390.)

When an attempt is made to draw the leg away from the other, it cannot be accomplished; but the thigh may be slightly bent across its fellow.

In general, a dislocation on the dorsum of the ilium is at once readily discriminated from a fracture of the neck of the thigh-bone, within the capsular ligament, by *the rotation of the limb inwards*; a position, which is unusual in a fracture of any part of the os femoris. "In a fracture of the neck of the thigh-bone, the knee and foot are generally turned outwards; the trochanter is drawn backwards; the limb can be readily bent towards the abdomen, although with some pain; but, above all, the limb, which is shortened from one to two inches by the contraction of the muscles, can be made of the length of the other by a slight extension, and when the extension is abandoned, the leg is again shortened. If, when extended, the limb is rotated, a crepitus can often be felt, which ceases when rotation is performed under a shortened state of the limb. The fractured neck of the thigh-bone, within the capsular ligament, rarely occurs but in advanced age, and often is the effect of the most trifling accidents, owing to the absorption which this part of the bone undergoes at advanced periods of life. Fractures, external to the capsular ligament, occur at any age; but generally in the middle periods of life; and these are easily distinguished by the crepitus which attends them, if the limb is rotated and the trochanter is compressed with the hand. The position is the same as in fractures within the ligament. The proportion of fractures of the neck of the thigh-bone, which I have seen, is at least four cases to one of dislocation." (*Sir A. Cooper, Surg. Essays*, part i. p. 28.) The rotation of the limb inward, in cases of fracture of the neck of the thigh-bone, is uncommon, though sometimes met with: Sir Astley Cooper saw one example of it under the care of Mr. Langstaff.

To reduce this dislocation, the patient should be placed on his back upon a table firmly fixed, or a large four-posted bedstead. A sheet folded longitudinally, is first to be placed under the perineum; and one end being carried behind the patient the other before him, they are to be fastened to one of the legs, or posts of the bed. Thus the pelvis will be fixed, so as to allow the necessary extension of the thigh-bone to be made. Great care must be taken during the extension to keep the testicles, or the pudenda in women, from being hurt by the sheet passed under the perineum. The patient must be further fixed by the assistants.

In France, Germany, and Ireland, the extending force is applied to the inferior part of the leg, in order that it may be as far as possible from the parts which resist the return of the head of the bone into its natural situation. In this country, surgeons generally prefer making the extension by means of a sheet, or the strap of a pulley, fastened round the limb just above the condyles of the os femoris. The direction in which Sir A. Cooper makes the extension, is in the line made by the limb, when it is brought across the other thigh a little above the knee. As soon as the head of the bone has been brought on a level with the acetabulum by the assistants, who are making the extension, the surgeon is to force it into this cavity by pressing on the great trochanter; or by rotating the knee and foot gently outwards, as practised by Sir A. Cooper.

The extension should always be made in a gradual and unremitting manner: at first, gently, but afterwards more strongly; never violently. The difficulty of reduction arises from the great power and resistance of the muscles, especially the glutei and triceps, which will at length be fatigued, so as to yield to the extending force, if care be taken that it be maintained the necessary time, without the least intermission. Sometimes, when there is difficulty in bringing the head of the bone over the lip of the acetabulum, Sir A. Cooper raises it by placing his arm under it near the joint.

The disappearance of all the symptoms, and the noise made by the head of the bone, when it slips into the acetabulum, denote that the reduction is effected. This noise, however, is not always made when pulleys are used or the patient is faint. The bone is afterwards to be kept from slipping out again, by tying the patient's thighs together with a bandage placed a little above the knees. The patient should be kept in bed at least three weeks; live low; and rub the joint with a camphorated liniment. Due time must be given for the lacerated ligaments to unite, and the sprained parts to recover; for premature exercise may bring on irremediable disease in the joint.

Mr. Hey sometimes made the extension in a right line with the trunk of the body; and, at the same time, directed the head of the bone outwards as well as downwards. A rotatory motion of the os femoris on its own axis, towards the spine, (the patient lying prone,) seemed to him likely to elevate the great trochanter, bring it nearer to its natural position, and direct the head of the bone towards the acetabulum. (*Hey's Practical. Obs.* p. 313.) He has given a case, in which the reduction was accomplished on these principles; the pelvis being fixed by the patient being put astride the bed-post, with the limb on the outside of the bed. Dr. James Scott, of Dublin, in one instance combined Hey's method of fixing the pelvis, by placing the patient astride a bed-post, with extension from the ankle. (See *Dubl. Hospital Reports*, vol. iii. p. 391.) However, as tartar emetic had been given, the success of the plan, after the failure of the common one, may have been rather owing to the influence of that medicine, than to any superiority of Hey's mode.

For the purpose of facilitating the reduction, surgeons often endeavour to produce a temporary faintness by a copious venesection, immediately before the extension is begun; a practice which, when the patient's state of health does not forbid it, is advisable, as materially lessening the resistance of the muscles. Sir A. Cooper gives it his general approbation, as well as the warm bath, and nauseating doses of tartarised antimony. After taking away from twelve to twenty ounces of blood, he places the patient in a bath heated to 100 degrees, and gradually raised to 110 degrees, until faintness is induced. While in the bath the patient is also to take a grain of tartarised antimony every ten minutes, until nausea is excited, when he is to be removed from the bath, put in blankets, and placed between two strong posts, in each of which a staple is fixed, or he may be placed on the floor, into which two rings may be screwed. Of Mr. Hey's plan, especially the direction of the limb in it, he entertains an unfavourable opinion, as little calculated to answer where the reduction has been at all delayed. (*On Dislocations*, p. 45.) In this sentiment I fully concur. In all cases of difficulty, the above-mentioned debilitating means, the intoxicating effect of a liberal dose of opium, and the use of pulleys for the reduction, deserve recommendation.

An instance of dislocation of the thigh-bone on the dorsum of the ilium, with fracture of the former bone, is recorded by Sir Astley Cooper: the dislocation was not at first detected, and afterwards no attempt to reduce the bone was considered prudent: — "The probability is that dislocation, thus complicated with fracture, will generally not admit of reduction, as an extension cannot be made until three or four months have elapsed from the accident, and then only with strong splints upon the thigh, to prevent the risk of disuniting the fracture." (*On Dislocations, &c.* p. 62.)

Mr. C. H. Todd had an opportunity of dissecting the hip-joint of a man, after the femur had been dislocated, on the dorsum of the ilium, the patient having died on the day after the accident from an injury of the head. The luxation had been reduced. "On raising the the gluteus maximus, a large cavity, filled with coagulated blood, was found between that muscle, and the posterior part of the gluteus medius. This was the situation, which had been occupied by the dislocated extremity of the femur. The gluteus medius and minimus were uninjured. The pyriformis, gemini, obturatores, and quadratus, were completely torn across. Some fibres of the pectinalis were also torn. The iliacus, psoas, and adductors were uninjured. The orbicular ligament was entire at the superior and anterior part only, and it was irregularly lacerated throughout the remainder of its extent. The inter-articular ligament was torn out of the depression on the head of the femur. The bones had not sustained any injury." Mr. Todd conceives, that, when this dislocation takes place, the force is applied to the inferior and external part of the limb, the thigh being at the time in the state of demiflexion; the head is thus pushed through the posterior and upper part of the orbicular ligament, passes under the posterior edge of the gluteus minimus, separating it from the pyriformis, and forms a cavity for itself under the gluteus maximus, or between the gluteus medius and minimus. (See *Dublin Hospital Reports*, vol. iii. p. 396 — 401.)

In an old unreduced partial dislocation on the dorsum of the ilium, dissected by Mr. Wallace, and of which he has published many interesting particulars, the posterior edge of the gluteus medius ran exactly over the head of the femur. The case had been attended with a fracture of the superior edge of the acetabulum. In consequence of the interruption of the natural movements of the limb, its muscles had become generally wasted, especially the rotators of it outwards, and the obturator internus had been transformed into a peculiar substance, resembling a mixture of fat and fibro-cartilage. It appeared to Mr. Wallace from what was noticed in this instance, that "nature does not appear to possess the power of forming articular cartilage in those accidental joints, which result from unreduced dislocations. The new articular surfaces are always covered by a lamina of bone, which resembles in appearance that ivory-like substance sometimes found on natural articular surfaces. As a cartilaginous surface cannot play easily on a bony surface, the original cartilage, which may have covered the head of the dislocated bone, becomes absorbed, and its situation occupied by the same kind of tissue, as that which forms the new surface, upon which the head of the bone may be applied. In accidental joints, the result of disunited fracture, the ends of the bones appear to be covered by an articular cartilage of original formation; it corresponds in its character to the temporary cartilage of bones, or, more properly speaking, it is bone in a state of imperfect formation." (*W. Wallace, in Trans. of King's and Queen's College, Ireland,* vol. v. p. 250.) The usual change in the shape of the unreduced head of the femur is noticed by this gentleman : in the case, adduced by him, one remarkable circumstance was the considerable elevation of the pelvis on the injured side ; a fact, which seems not to agree with a common description of the cause of the opposite kind of obliquity in the position of the pelvis in disease of the hip. With respect to the changes, which take place in the head of a dislocated bone, and the kind of accidental joint which often follows, Sir Astley Cooper has adverted to certain differences depending on the texture, whether muscular, or osseous, on which the head of the bone is lodged.

Dr. James Scott had an opportunity of dissecting a hip, in an example of dislocation of the femur, upwards and backwards, where the patient had died, in consequence of a laceration of the intestines, forty-eight hours after the accident, and forty hours after the reduction. Amongst other particulars, the following are recorded : — "The gluteus maximus being raised from its origin, a considerable extravasation was found in the loose cellular tissue under the gluteus medius. A cavity, capable of containing a pullet's egg, was also brought into view. This cavity was situated directly where the great ischiatic nerve passes under the pyriform muscle ; it contained fluid blood ; its boundaries were the pyriformis above, the sciatic nerve before (supposing the body upright), the trochanter major and insertion of the gluteus medius external and posterior. Here the displaced head of the bone had been lodged. The fleshy substance of the gemini and quadratus muscles was found torn across. The pyriformis and obturator internus were perfect. The internal and upper part of the capsular ligament was ruptured ; the external portion remained unbroken." The ligamentum teres was torn from its insertion into the dimple of the head of the femur, but not itself ruptured. The same fact was exemplified in Mr. Todd's case. The brim of the acetabulum at the upper part was fractured, to the extent of about an inch ; and the fragment lay loose, and nearly unconnected. A fracture also traversed the acetabulum.

A case is recorded by Sir Astley Cooper, where a portion of the edge of the acetabulum was broken off. Dr. James Scott thinks it probable, that, in many instances of dislocation upwards, the brim of the acetabulum is fractured, and to this circumstance he ascribes the occasional tediousness of the recovery after reduction. (See *Dublin Hospital Reports*, vol. iii. p. 389.) Probably, if the head of the femur had been replaced soon after the occurrence of the injury, it would have been exceedingly difficult to maintain it in this state ; but, as Mr. Wormald has remarked, the difficulty would have depended upon the size of the portion of the acetabulum broken off.

Luxations downwards and forwards, upon the obturator foramen, are the next in frequency to those upon the dorsum of the ilium. The accident is facilitated by the great extent to which the abduction of the thigh can be carried, and by the weakness of the orbicular ligament, which in this direction is torn through. According to Sir Astley Cooper, "The dislocation in the foramen ovale happens whilst the thighs are widely separated, during which the ligamentum teres is upon the stretch ; and when the head of the bone is thrown from the acetabulum, *the ligament is torn through* before it entirely quits the cavity." (*On Dislocations, &c.* p. 65.) It seems also that the pectinalis and adductor brevis muscles are sometimes lacerated: (See *Case*, vol. cit. p. 66.) The head of the bone is thrown between the obturator ligament, and obturator externus muscle.

The symptoms are as follows :—The injured limb is two inches longer than its fellow, the head of the femur being lower than the acetabulum ; the trochanter major, which is less prominent than natural, is removed to a greater distance from the anterior superior spinous process of the ilium, and the thigh is flattened in consequence of the elongation of the muscles. A hard round tumour, formed by the head of the femur, is felt at the inner and superior part of the thigh, towards the perineum. The leg is slightly bent ; and the foot, though widely separated from the other, is generally turned neither outwards nor inwards ; but, there may be a little variation in this respect, in different instances. Hence, Sir A. Cooper prefers as the diagnostic symptoms, the bent position of the body, caused by the psoas and iliacus muscles being on the stretch ; the separated knees ; and the increased length of the limb. (*Essays*, part 1. p. 37.) The latter symptom alone is a sufficient indication of the case not being a fracture.

In general, dislocations on the obturator foramen, are easy of reduction. The pelvis having been fixed, the extension is to be made downwards and outwards, so as just to dislodge the head of the bone. The muscles then generally draw it into the acetabulum, on the extending force being gradually relaxed, if the upper part of the bone be pulled outward, with a bandage, and the ankle be at the same time inclined inwards. Thus the limb is used as a lever, with very considerable power.

Mr. Hey says, that "in this species of dislocation (downwards and forwards,) as the head of the bone is situated lower than the acetabulum, it is evident, that an extension made in a right line with the trunk of the body, must remove the head of the bone farther from its proper place, and thereby prevent, instead of assisting, reduction. The extension, he conceives, ought to be made with the thigh at a right angle, or inclined somewhat less than a right angle, to the trunk of the body. When the extension has removed the head of the bone from the external obturator muscle, which covers the great foramen of the os innominatum, the upper part of the os femoris must then be pushed or drawn outwards ; which motion will be greatly assisted by moving the lower part of the os femoris at the same moment, in a contrary direction ; and, by a rotatory motion of the bone upon its own axis, turning the head of the bone towards the acetabulum." (*Hey*, p. 316.)

The *thigh-bone* is sometimes *luxated upwards and forwards on the pubes.* The whole limb is turned outwards, and cannot be rotated inwards : it is shortened by one inch ; the trochanter major is nearer the anterior superior spinous process of the ilium than natural ; the head of the bone forms a tumour in the groin above the level of Poupart's ligament, on the outer side of the femoral artery and vein, where it can be perceived to move when the thigh-bone itself is moved. By the stretching of the anterior crural nerve, which lies over the neck of the bone, (see *A. Cooper, on Dislocations*, p. 95.) great pain, numbness, and even paralysis, are liable to be produced. The knee is generally carried backwards. Sir A. Cooper remarks, that there is a slight flexion of the limb forwards and outwards. (*Surgical Essays*, part i. p. 45.)

The head of the bone felt in the groin, and the impossibility of rotating the limb inward, distinguish this case from a fracture of the neck of the bone.

In the reduction, Sir A. Cooper recommends the extension to be made in a line behind the axis of the body, so as to draw the thigh-bone backwards; and, when such extension has been continued some time, a napkin is to be put under the upper part of the bone, and its head lifted over the pubes and edge of the acetabulum.

In the *dislocation of the thigh backwards on the ischiatic foramen*, the head of the bone is placed on the pyriformis muscle, between the edge of the bone which forms the upper part of the ischiatic notch and the sacrosciatic ligament, being behind the acetabulum, and a little above the level of the middle of that cavity. The limb is generally not more than half an inch shorter than its fellow; and the knee and foot are turned inwards, but not nearly in so great a degree as in the dislocation on the dorsum of the ilium. The thigh inclines a little forward, the knee is slightly bent, and the limb is so fixed, that flexion and rotation are in a great measure prevented.

Sir A. Cooper considers this dislocation as the most difficult, both to detect and reduce: difficult to detect, because the length of the limb, and the position of the knee and foot, are but little changed; difficult to reduce, because the head of the bone is placed deeply behind the acetabulum, and requires to be drawn over the edge of the socket, as well as towards it. In thin subjects, a hard tumour is felt at the posterior and inferior part of the buttock, and the great trochanter is removed further from the spine of the ilium.

The pelvis being fixed, the extension is to be made downwards and forwards, across the middle of the other thigh, so as to dislodge the head of the bone, while the surgeon, with a napkin, placed just below the trochanter minor, pulls the upper part of the femur towards the acetabulum. In this case pulleys are preferable for making the extension.

A *dislocation on the tuber ischii* is exceedingly uncommon. The particulars of such a case were published a few years ago by Mr. Keate. A gentleman's horse fell with him into a ditch, and he lay under the animal for some time. It seems that, during his efforts to release himself, the head of the femur, which had been first thrown upon the obturator foramen, was forced behind the tuberosity of the ischium, where it could be plainly felt. The limb was lengthened and everted. In the reduction, the head of the bone was brought first on the obturator foramen, and thence into the acetabulum, without any particular difficulty. (See *Lond. Med. Gaz.*) But it appears, from a case lately recorded, that the head of the femur may be primarily dislocated downwards and backwards upon the tuberosity of the ischium. A maniac leaped from a third story window; and died, in about an hour, from the injuries which he received. One of the thighs was considerably *shortened* and *inverted*, forming about half a right angle with the body. The shaft of the femur, crossing the symphysis pubis, was immoveably fixed in this situation. "Twelve hours after death (says Mr. Wormald) I commenced the dissection by reflecting the gluteus maximus, when I found some of the fibres of the gluteus medius and minimus ruptured at their posterior edge. The pyriformis and the gemelli were also partially torn; but the four portions of the tendon of the obturator internus, which pass through the lesser sacro-ischiatic notch, were drawn out, and separated from their connections with the muscular fibres. The head of the femur presented itself through a rent of the capsule, opposite to the upper part of the tuber ischii, above the quadratus, so that the great ischiatic nerve was somewhat displaced, and pressed against the tuber ischii." The head of the bone lay under the outer edge of the gluteus maximus. Mr. Wormald expresses his belief, that, if this man had been in a state to admit of an attempt at reduction, it might have been accomplished, without any unusual difficulty, by fixing the pelvis, and employing extension in the direction of the shaft, and everting the limb, so as to bring the head of the femur opposite the rent in the capsule. (See *Lond. Med. Gaz. for* 1836, 1837. p. 657.) The position of the limb in this case seems to have been very different from what it was in the case of secondary displacement of the head of the femur behind the tuber ischii, recorded by Mr. Keate.

Mr. Wormald has published the following case, in which there was a dislocation of the head of the femur, with displacement of a portion of the cotyloid ligament, without rupture of the ligamentum teres:—In the summer of 1829, a man about forty years of age, was admitted into St. Bartholomew's Hospital, for pneumonia, of which he died. On examining his body, Mr. Wormald noticed, that the left lower extremity was somewhat everted, a little separated from the right, and shortened to the extent of half an inch: and, on dissection, the head of the femur was found resting upon the ilium, between the acetabulum and the anterior inferior spine, in a cavity formed partly by a growth of bone and partly by what seemed to Mr. Wormald to be the upper portion of the original cotyloid ligament; the acetabulum was contracted, and filled up by a fibrous substance. The ligamentum teres was entire, elongated, and flattened. Fourteen years before the patient died, he had met with the injury of his hip by a fall from a ladder; but eventually recovered from the accident, and was able to follow the employment of carrying out beer. Mr. Wormald thinks it probable, that a portion of the acetabulum had been separated, as well as the cotyloid ligament. (See *Lond. Med. Gaz. for* 1836, 1837. p. 658.)

Since this sheet was sent to the press, I have perused some interesting remarks on an unusual dislocation of the thigh-bone, by Mr. Travers, junior. It was produced by a fall into the hold of a ship. The "buttock is flattened; the trochanter is felt rather below, and to the outer side of the anterior and superior spinous process of the ilium. The neck of the bone lies apparently between the two anterior spinous processes, so that, when the patient is erect, the limb appears slung or suspended from this point. The head of the bone cannot be felt; it is invested by an abundance of bony matter, &c. There is complete eversion, slight mobility, and imperfect progression with the aid of a crutch." (See *Med. Chir. Trans.* vol. xx. p. 113.) A similar case has been recorded by Mr. Morgan. (See *Guy's Hospital Reports.*) Mr. Travers, junior, refers also to Mr. Bransby Cooper's instance, published in this last work, of a partial dislocation upwards; and he mentions two preparations in the Museum of St. Bartholomew's Hospital, exhibiting the head of the dislocated femur in new and unusual situations, not merely backwards, but *downwards.* "In the first, which was removed one week after the receipt of the injury, the head of the bone is seen resting upon the sciatic spine, and lesser sciatic opening. The lower border of the cervix femoris being partially in contact with the upper and outer edge of the tuberosity, the small rotator muscles are lacerated. The lesser glutœi, and pyriform muscles are entire at their place of insertion." In this case, a fracture of the os innominatum traverses the bottom of the acetabulum. The trochanter lies considerably higher, than the head of the bone. In the second specimen, the bone had been reduced, but the rent is manifest at the back and outer part of the capsule, through which the head of the bone had passed to, and been found moveable upon, a spot corresponding to the root of the spine of the ischium. Mr. Travers, junior, infers from these cases, that, in addition to the four kinds of luxations of the head of the femur usually described, we must now admit the possibility of other rarer displacements of it, where it assumes a position either directly *above* or *below* the acetabulum.

The subject of congenital, or original, dislocations of the thigh-bone, was first taken up by Palletta (*Adversaria Chirurgica Prima; et Exercitatio de Claudicatione Congenita, &c.* ab. Ed. Sandifort edit. 8vo. Lugd. 1788.) Delpech afterwards made some observations upon it (*De l'Orthomorphie, &c.* 2 tomes, 8vo. 1828); but the most important article, yet extant on congenital, or original, dislocations of the hip, is that by the celebrated Dupuytren. (See *Répertoire Gén. d'Anat.* t. ii.; also *Clin. Chir.* t. iii. art. 8.) Cruveilhier has given the engraving of a skeleton, in which, amongst other peculiarities, is exhibited a congenital displacement of the thigh-bones. (*Anat. Pathol.* livr. ii. pl. 2.) The case consists in a displacement of the head of the femur from the acetabulum to the dorsum of the ilium, existing from birth, and appearing to be the result of a want of depth, or of the incomplete formation of the acetabulum, rather than of any accident or disease. The displacement corresponds to that termed upwards and outwards, and would appear sometimes to prevail in certain families. (See *Clin. Chir.* t. iii. p. 216.) According to Dupuytren, the characters of this dislocation are; a shortening of the limb; an ascent of the head of the bone upon the external fossa of the ilium; a projection of the great trochanter; a retraction of almost all the muscles of the upper part of the thigh towards the crista of the ilium, where they form round the head of the femur a kind of cone, the base of which is in the os ilium, and the apex at the great trochanter. The tuberosity of the ischium, quitted by these muscles, is nearly uncovered. The limb is rotated inwards, and consequently the heel and ham are turned outwards, and the knee and toes inwards. The position of the thigh is oblique from above downwards, and from without inwards; which obliquity is greater, the older the individual is, and the wider the pelvis. Hence, there is a tendency in the thigh-bones to cross one another below. There is a meagreness of the limb, and especially of its upper part, out of all proportion to the trunk and upper extremities.

The separate movements of limbs, with this conformation, are generally very limited, and, in particular, those of abduction and rotation. As the patient is standing still, one is struck with the want of proportion between the upper and lower parts of this body, with the imperfection of his lower limbs, and the attitude which he assumes. The trunk is fully developed, while the lower extremities are short and slender, as if they belonged to another person. This appearance of the lower limbs is rendered still more conspicuous by the breadth of the pelvis. One is also struck with the projection of the great trochanters. The upper part of the trunk inclines a good way back, while the lumbar portion of the spine advances far forwards, and is very much excavated behind. The pelvis is placed almost horizontally on the thigh-bones; and the ground is only touched with the point of the foot. It appears from Dupuytren's observation, that a person, with congenital dislocation of the hips, runs and jumps, with less difficulty than he walks. When he is placed upon his back, the signs of the malformation diminish, and are nearly effaced; because, in this posture of repose, the muscles no longer draw the thigh-bones upwards, and the weight of the upper parts of the body ceases to press the pelvis down between the heads of those bones. In this posture, the limbs may be lengthened, or shortened, with perfect facility; and this from one to three inches, according to the age and stature of the individual, and the extent of displacement. These changes in the length of the limb, are not only made with great ease, but without any pain; so as to prove the absence of every kind of disease, as well as of a cavity proper for receiving and retaining the head of the bone.

In twenty-six cases, met with by Dupuytren, the luxation existed on both sides, with the exception of two or three. Most of the individuals, who have had the infirmity, have been females; and, in the above twenty-six, there were only three or four males. (*Clin. Chir.* t. iii. p. 251.)

Of course, the treatment can be but palliative. As the weight of the trunk aggravates the displacement, repose may be useful; but it is not necessary to keep the patient in the recumbent position; because, in the sitting posture, there is no stress upon the thigh-bones, the body resting entirely on the tuberosities of the ischia. Let these individuals, therefore, choose a profession, which will keep them a good deal in the sitting posture. Dupuytren also commends cold bathing, and a bandage, or belt, round the pelvis, by which the trochanters may be combined and kept steadily at a uniform height. (See *Dupuytren Op.* et vol. cit. art. 8.) Besides the sources of information already quoted, I refer to *Caillard Billonière sur les Luxations originelles, ou Congénitales des Femurs,* 8vo. Paris, 1828; John North, in *Med. Chir. Trans.* vol. 19. *Rolade Lafonde; sur les Principales Difformités du Corps Humain, &c.* 2 vols. 4to.

Paris, 1819; and to *W. Coulson on Disease of the Hip-joint*, p. 68. 4to. Lond. 1837.

Dislocations of the Patella.

The patella may be luxated outwards, or even inwards, when violently pushed in this direction. It is also liable to a displacement upwards, in consequence of its ligament being sometimes ruptured by the action of the extensor muscles. It is most frequently thrown on the external condyle, where it produces a projection; and this circumstance, with an incapacity of bending the knee, is evidence of the nature of the injury. (*Sir A. Cooper, Surgical Essays*, part i. p. 66.) The accident is most common in persons, whose knees incline inwards; a condition that accounts for the tendency of the patella to be drawn outwards by the action of the extensor muscles. The dislocation inwards, which is much less frequently met with, is produced either by a fall upon a projecting body, which strikes the outer edge of the patella, or by the foot being turned inwards at the time of the fall.

In each case, if there be no previous morbid relaxation of the parts, a portion of the capsular ligament will be torn. (*A. Cooper, on Dislocations, &c.* p. 179.) When the extensors of the leg have been completely relaxed by position, the reduction is, for the most part, easily accomplished by pressing the patella towards its right place with one or both thumbs. In a case, under Mr. George Young, success could not be obtained, except by extending the leg, and placing the heel on the surgeon's shoulder, who, with the limb thus fixed, was enabled to make the requisite pressure on the patella advantageously with both his thumbs. Owing to a lax state of the ligament of the patella, or other predisposing causes, the bone is sometimes difficultly kept in its proper situation, unless a roller be applied. The inflammatory affection of the joint is to be opposed by bleeding, purging, and the use of the lotio plumbi subacetatis. The joint must be kept quiet a few days, and then gently moved in order to prevent stiffness. When the relaxation of the ligaments is such, that a relapse is likely to ensue from slight causes, a laced knee-cap, with a strap and buckle, above and below the patella, should be worn as recommended by Sir Astley Cooper. (*On Dislocations*, p. 181.) The luxation of the patella upwards, from a rupture of its ligament, is a case followed by a considerable degree of inflammation. Hence, Sir Astley Cooper particularly recommends early depletion, the use of evaporating lotions from four to seven days, and then a roller to the foot and leg. The leg is to be kept extended by means of a splint behind the knee; a leather strap is to be buckled round the lower part of the thigh, and to it, on each side, another is buckled, which extends from the sole of the foot, and is carried up each side of the leg. Thus the patella is kept down, and an opportunity is afforded for the ligament to unite. In a month, the knee may be gently moved every day. (*On Dislocations*, p. 182.)

Dislocations of the Knee.

The upper head of the tibia may be luxated forward, backward, or to either side. Complete dislocations are exceedingly rare; because the articular surface of the condyles of the femur is so extensive, that the tibia cannot be entirely removed from it, without a prodigious laceration of the ligaments, tendons, and all the rest of the soft parts.

The condyles of the femur are disposed in such a manner, that, in the extreme flexion of the leg, the articular cavities of the upper head of the tibia are still in contact with those bony eminences; and this circumstance, together with the resistance made by the ligament of the patella, the patella itself, and the tendon of the extensor muscles of the leg, renders a sudden dislocation of the tibia backwards so difficult, that Boyer seems even to question the possibility of the accident, notwithstanding the case recited by Heister. (*Traité des Mal. Chir.* t. iv. p. 366.) That this accident, however, sometimes really happens, no longer admits of dispute: the case is noticed by Sir A. Cooper as producing the following appearances:—A shortened state of the limb; a projection of the condyles of the os femoris; a depression in the situation of the ligament of the patella; *and a bending of the leg forwards:* which last statement differs from that of Boyer, who declares, that the leg is bent to a very acute angle, and cannot be extended again. (*Mal. Chir.* t. iv. p. 369.) It appears further, from the particulars of the example of this accident seen by Dr. Walshman, that the dislocation may even be complete, the head of the tibia being thrown behind the condyles of the femur into the ham. The tendinous connection of the patella to the rectus muscle was ruptured; and, probably, without a laceration of that tendon, or of the ligament of the patella, such a degree of displacement could scarcely have happened. (*Surgical Essays*, part ii. p. 74.)

But, if a sudden dislocation of the tibia from the femur backwards is uncommon, the same remark cannot be made respecting a displacement in that direction, gradually produced by the effects of disease. Several cases of the latter kind have fallen under my own observation.

A dislocation of the head of the tibia forwards, from the condyles of the femur, cannot happen, without the greatest difficulty; for the accident would be likely to be attended with a laceration of the lateral, crucial, and oblique, or posterior ligaments, all which tend to prevent the leg from being too far extended; and in addition to all this injury, Boyer calculates, that the heads of the gastrochemius, the popliteus, and the extensor tendons of the leg, would be immoderately stretched, and even torn. However, it deserves notice, that, in one compound luxation of the knee, where the os femoris was thrown behind the outer side of the head of the tibia, the external condyle being dislocated backwards and outwards, and the internal one thrown forwards upon the head of the tibia, the dissection proved, that "neither the sciatic nerve, the popliteal artery and vein, the lateral, nor the crucial ligaments were ruptured." (*Sir A. Cooper, on Dislocations*, p. 197.) Both heads of the gastrocnemius were lacerated, and the back portion of the capsular ligament extensively torn. In 1802, an instance of a luxation of the tibia forwards was seen in Guy's Hospital. According to Sir Astley Cooper, while the tibia projects forward the thigh-bone is depressed, and thrown somewhat laterally as well as backwards. The os femoris makes such pressure on the popliteal artery, as to prevent the pulsation of the anterior tibial artery on the instep; and the patella and tibia are drawn forwards by the rectus muscle. (*Surgical Essays*, part ii. p. 73.)

Dislocations inwards or outwards, though more frequent than the foregoing cases, are still to be considered as rare, and are always incomplete. In the dislocation inwards, the condyle of the os femoris is thrown upon the external semilunar cartilage, and the tibia projects at the inner side of the joint, so as at once to disclose the nature of the accident; and a depression may be felt under the external condyle. Such a case was brought into the North London Hospital in the autumn of 1836; and was easily reduced by Mr. Hallam, then one of the house surgeons. In the luxation of the head of the tibia outwards, the condyle of the os femoris is thrown upon the inner semilunar cartilage, or, as Sir Astley Cooper says, rather behind it. In both these cases, this gentleman believes, that the tibia is rather twisted upon the os femoris, so that the condyle of the latter bone is thrown somewhat backwards, as well as outwards, or inwards.

I have stated, that lateral luxations of the tibia from the femur are almost always incomplete; but, the possibility of a complete dislocation inwards seems to be established by the 402d Obs. of Lamotte.

Whenever the tibia is dislocated from the femur, the accident has generally happened either while some force was operating upon that bone, at a period when the femur was fixed and immoveable, or else while the thigh-bone was propelled, or twisted with great violence, while the leg itself was firmly fixed.

These accidents are all easily reduced by making gentle extension, and pushing the head of the tibia in the proper direction. The grand object, after the reduction, is to avert inflammation of the knee, and promote the union of the torn ligaments. The first demands the rigorous observance of the antiphlogistic plan — bleeding, leeches, low diet, opening medicines, and a cooling evaporating lotion; both require the limb to remain perfectly motionless. With respect to splints, I conceive, that their pressure would be objectionable. As soon as the ligaments have grown together, and the danger of inflammation is over, which will be in about three weeks, the joint should be gently bent and extended every day, in order to prevent stiffness. Liniments will afterwards be of service.

I have next to notice the cases, which were first described by the late Mr. Hey, and are named by Sir A. Cooper *partial luxations of the thigh-bone from the semilunar cartilages*. Mr. Hey observes, that the disorder may happen either with or without contusion. When no contusion has occurred, or the effects of it are removed, the joint, with respect to shape, appears uninjured. If there is any difference from its usual appearance, it is that the ligament of the patella seems rather more relaxed than that of the sound limb. The leg is readily bent, or extended by the hands of the surgeon, and without pain to the patient: at most, the degree of uneasiness, caused by this flexion and extension, is trifling. But, the patient himself cannot freely bend, nor perfectly extend the limb in walking; and he is compelled to walk with an invariable and small degree of flexion. Yet, though the leg is stiff in walking, it may be freely moved, while the patient is sitting down.

Mr. Hey ascribed this complaint to any causes which had the effect of hindering the condyles of the os femoris from moving truly in the hollow formed by the semilunar cartilages, and articular depressions of the tibia; an unequal tension of the lateral, or crucial ligaments; or some slight derangement of the semilunar cartilages. (*Pract. Obs.* p. 333. ed. 2.) Sir A. Cooper says, the most frequent cause of the accident is the point of the foot, while averted, striking against any projection, when pain is immediately felt in the knee, and the patient becomes incapable of perfectly extending the leg. He has also known the case produced by a person suddenly turning in bed, and the clothes not suffering the foot to turn as quickly as the rest of the body. A sudden twist of the knee inwards may also displace the semilunar cartilages.

Sir A. Cooper gives the following explanation of the case:—The semilunar cartilages are united to the tibia by ligaments, which, when relaxed, allow the cartilages to be easily pushed from their natural situation by the condyles of the femur, which then come into contact with the head of the tibia; and now, upon an attempt being made to extend the leg, a complete movement of this kind is prevented by the edges of the semilunar cartilages. (*Surgical Essays*, part ii. p. 76.) In several examples recorded by Mr. Hey, a cure was effected by placing the patient upon an elevated seat, extending the joint, while one hand was placed above the knee, and then suddenly moving the leg backwards, so as to make as acute an angle with the thigh as possible. (*Pract. Obs.* p. 337, &c.) This manœuvre seems to have the effect of restoring the semilunar cartilages to their natural position. Sometimes, however, it will not answer; and, in one such case, mentioned by Sir A. Cooper, the patient used to accomplish the reduction by sitting upon the ground, and then bending the thigh inwards and pulling the foot outwards. A knee-cap laced tightly, and furnished with a strong leather strap just below the patella, was requisite in this instance for preventing a return of the displacement. In another case, subject to frequent relapses, these were at length hindered by a bandage with four rollers attached to it, which were tightly applied above and below the patella. (*Sir A. Cooper, Surgical Essays*, part ii. p. 77.)

Compound dislocations of the knee generally demand immediate amputation.

Dislocations of the Fibula.

According to Sir A. Cooper, luxations of the upper head of the fibula, from relaxation of the ligaments, are more frequent than those from violence. The head of the bone is thrown backwards. The bone is easily replaced, but immediately slips behind the tibia again. When the case is attended with disease, repeated blisters are recommended; and, afterwards, a strap to confine the bone in its natural situation. (*Surg. Essays*, part ii. p. 105.) In other instances, a roller, a compress applied over the head of the fibula, and a splint along this bone, would be proper. (*Boyer, Mal. Chir.* t. iv. p. 374.) The latter author has seen a displacement of the whole fibula upwards, accompanying a dislocation of the foot outwards. This case must be exceedingly unfrequent, as it is resisted not only by the ligaments of the upper joint of the fibula, but also by those very strong ligamentous bands, which bind the malleolus externus to the astragalus and os calcis. In all the cases which I have seen, the pressure of the astragalus, when driven outwards, has broken the fibula. In the instance mentioned by Boyer, the double luxation of the fibula was readily reduced, by rectifying the position of the foot, and bringing the astragalus into its proper place again with respect to the tibia.

Dislocation of the Foot.

The tibia may be dislocated from the astragalus inwards, or outwards; forwards, or backwards; and either of these luxations may be complete or incomplete. The dislocation inwards is the most common; the foot being thrown outwards, and its inner edge resting upon the ground, while the fibula is broken about two or three inches above the ankle. Upon dissection, as Sir A. Cooper observes, the end of the tibia is found resting upon the inner side of the astragalus; and, if the accident has been produced by a jump from a considerable height, the lower end of the tibia, where it is connected to the fibula by ligament, is split off, and remains attached to the latter bone. The broken end of the fibula itself is carried down upon the astragalus, occupying the natural situation of the tibia. The malleolus externus remains in its natural situation, with two inches of the fibula, and the piece of the tibia, which is split off. The capsular ligament, attached to the fibula, and the three strong fibular tarsal ligaments, are uninjured. (*Surgical Essays*, part ii. p. 107.)

One thing very essential to be understood in this case, is, that the fracture of the fibula is here the first mischief, without which the dislocation could not have happened. The fibula may easily be fractured without any luxation of the foot, but the above-described dislocation can never take place unpreceded by a fracture of the fibula; and, grave and serious as the displacement of the joint is, it is always a secondary event. (*Dupuytren, Annuaire Méd. Chir.* 1819. p. 3.)

It was to this particular case, joined with the fracture of the fibula, that Mr. Pott drew the attention of surgeons, as affording a striking example of the benefit derived from relaxing the muscles: I mean the instance, in which, "by leaping or jumping, the fibula breaks within two or three inches of the lower extremity. When this happens, the inferior fractured end of the fibula falls inwards towards the tibia; that extremity of the bone which forms the outer ankle is turned somewhat outward and upward; and the tibia having lost its proper support, and not being of itself capable of preserving its true perpendicular bearing, is forced off from the astragalus inwards; by which means, the weak bursal, or common ligament of the joint, is violently stretched, if not torn, and the strong ones, which fasten the tibia to the astragalus and os calcis, are always lacerated; thus producing, at the same time, a perfect fracture and a partial dislocation, to which is sometimes added a wound in the integuments, made by the bone at the inner ankle. By this means, and indeed as a necessary consequence, all the tendons which pass behind or under, or are attached to the extremities of the tibia and the fibula, or os calcis, have their natural direction and disposition so altered, that, instead of performing their appointed actions, they all contribute to the distortion of the foot, and that by turning it outward and upward."

When this accident is accompanied, as it sometimes is, with a wound of the integuments of the inner ankle, and that made by the protrusion of the bones, the danger and difficulties of the case are seriously increased.

"By the fracture of the fibula, the dilatation of the bursal ligament of the joint, and the rupture of those which should tie the end of the tibia firmly to the astragalus and os calcis, the perpendicular bearing of the tibia on the astragalus is lost, and the foot becomes distorted; by this distortion the direction and action of all the muscles already recited are so altered, that it becomes (in the usual way of treating this case) a difficult matter to reduce the joint; and, the support of the fibula being gone, a more difficult one to keep it in its place after reduction. If it be attempted with compress and strict bandage, the consequence often is a very troublesome, as well as painful ulceration of the inner ankle, which very ulceration becomes itself a reason why such a kind of pressure and bandage can be no longer continued; and if the bone cannot be kept in its place, the lameness and deformity are such as to be very fatiguing to the patient, and to oblige him to wear a shoe with an iron, or a laced buskin, or something of that sort, for a great while, or perhaps for life.

"All this trouble, pain, difficulty, and inconvenience, are occasioned by putting and keeping the limb in such position as necessarily puts the muscles into action, or into a state of resistance, which in this case is the same. This occasions the difficulty in reduction, and the difficulty in keeping it reduced; this distorts the foot; and by pulling it outward and upward, makes that deformity which always accompanies such accident: but if the position of the limb be changed; if, by laying it on its outside, with the knee moderately bent, the muscles forming the calf of the leg, and those which pass behind the fibula, and under the os calcis, are all put into a state of relaxation and non-resistance, all this difficulty and trouble do in general vanish immediately; the foot may easily be placed right, the joint reduced, and by maintaining the same disposition of the limb, everything will in general succeed very happily, as I have many times experienced." (*Pott.*)

I think the profession are much indebted to Sir A. Cooper, for his application of terms to dislocations of the ankle, which are liable to no mistake, or confusion. Thus, when he speaks of a dislocation of the tibia inwards or outwards, backwards or forwards, the case spoken of is immediately known. On the contrary, when authors write about dislocations of the ankle, or foot, in any named direction, their meaning may be various and misinterpreted. We find this exemplified in Dupuytren's valuable memoir on fractures of the lower end of the fibula; for, instead of terming the above case, a dislocation of the foot *outwards*, as the generality of writers have done, he thinks it should be named a dislocation of the foot *inwards*, on account of the direction in which the astragalus is carried. (*Annuaire Méd. Chir.* p. 3. 1819.)

With respect to the treatment of the preceding case, Dupuytren admits that Pott's method easily effects a reduction, though incapable of maintaining it, and consequently he prefers a method of treatment, which will be explained in the part of the article Fracture, relating to fractures of the fibula. Sir A. Cooper adopts Pott's principles; but gives one essential piece of advice, which is, that the splint upon which the outer part of the limb rests, may have a foot-piece, "to give support to the foot, prevent its eversion, and preserve it at right angles with the leg. If much inflammation succeeds, leeches are to be applied to the parts, and the constitution will require relief by taking blood from the arm." (*Surgical Essays*, part ii. p. 108.)

When the tibia is dislocated outwards, the internal lateral ligaments are always ruptured, or pulled away from the bones, and the inner malleolus broken previously to the fracture of the fibula. On a part of this statement, however, Dupuytren and Sir A. Cooper differ, as the latter mentions, that the deltoid ligament remains unbroken. In some cases, he says, the fracture is not confined to the malleolus, but passes obliquely through the articular surface of the tibia, which is thrown forwards and outwards upon the astragalus, in front of the malleolus externus. Sometimes, the astragalus is fractured, and the lower extremity of the fibula broken into several splinters. He states, also, that when the fibula is not broken, the external lateral ligaments are ruptured. The foot is thrown inwards, its outer edge resting upon the ground; while a considerable projection is made by the malleolus externus under the skin. The accident is generally caused by the passage of the wheel of a carriage over the leg, or a violent twist of the foot inwards in jumping, or falling. (*Sir A. Cooper*, vol. cit. p. 113.)

The reduction is accomplished by relaxing the muscles of the calf, making extension in the axis of the leg, and pressing the lower head of the tibia inwards towards the stragalus. "The limb is to be laid upon its outer side, resting upon a splint with a foot-piece, and a pad is to be placed upon the fibula just above the outer angle, and extending a few inches upwards, so as in some measure to raise that portion of the leg, and prevent the tibia and fibula slipping from the astragalus, as well as lessen the pressure of the malleolus externus upon the integuments." (*Surg. Essays*, part ii. p. 113.) Sir A. Cooper also enjoins paying the strictest attention to hindering the foot from being twisted inwards, or pointed downwards.

A complete dislocation of the lower head of the tibia forwards cannot happen without the fibula being first broken, and either the base of the malleolus internus fractured, or its point torn away. The foot being then acted upon by the extensor and flexor muscles, and unretained by the malleoli and their ligaments, yields to the powerful operation of the muscles of the calf; the astragalus passing behind the tibia, while this projects forward under the tendons and skin of the instep. (*Dupuytren, Annuaire Méd. Chir.* p. 187. 4to. Paris, 1819.) The foot of course is much shortened, the heel lengthened, and firmly fixed, and the toes point downwards. Upon dissection, the tibia is found to rest upon the upper surface of the os naviculare, and os cuneiforme internum. The anterior part of the capsular ligament is torn through; the deltoid ligament is only partially lacerated; and the three ligaments of the fibula remain unbroken. (*Sir A. Cooper*, vol. cit. p. 109.)

This case is much more difficult of reduction than the instance in which the foot is thrown inwards; and the cause is owing to the powerful manner in which the muscles resist the extension of the parts, and placing them in their natural position again. As Dupuytren observes, it is true that such resistance may be lessened by relaxing the muscles, and drawing the patient's attention from his limb; plans, which fully answer for the reduction of the above-mentioned case; yet, in that now under consideration, they are insufficient. and here a greater effort is required to bring the foot from behind forwards, and to place the astragalus under the tibia. And, a still greater difficulty is to keep the parts reduced during the time necessary for the fibula and torn ligaments to be firmly united. In fact, the upper surface of the astragalus, which is convex from behind forwards, is so slippery, that it is hard to make the tibia rest securely on the articular pulley of that bone, which is itself incessantly acted upon by the extensor muscles of the leg, so as to have a tendency to slip behind the lower head of the tibia. In addition, therefore, to the bent posture, Dupuytren deems it necessary here to employ an apparatus, which propels the foot forward, and the lower head of the tibia backwards. (*Annuaire Méd. Chir.* p. 188.)

Sir A. Cooper prefers keeping the limb upon the heel, resting upon a pillow. A splint, with a suitable pad, and a foot-piece, is to be applied to each side of the leg, care being taken to keep the foot well supported at a right angle with the leg. (*Surgical Essays*, part ii. p. 110.)

I have no doubt that placing the limb on M'Intyre's apparatus, as done at the North London Hospital, is quite as good a method of treating all dislocations of the ankle, with fracture of the fibula, as any yet proposed, not excepting even that of Dupuytren; which will be noticed in the article Fracture.

Besides the complete dislocation of the tibia forwards, a partial case is sometimes met with, where one half of the articular surface of the bone rests upon the os naviculare, and the other on the astragalus. According to Sir. A. Cooper, the fibula is broken; the foot appears but little shortened; nor is there any considerable projection of the heel. The foot points downwards; it cannot be put flat on the ground, and is nearly stiff; and the heel continues drawn up. The accident, if not detected and rectified in its early stage, afterwards admits of no relief; the change in the state of the muscles, and the position in which the fibula has united, not suffering any reduction, even though great force be employed.

Dislocations of the tibia, forwards or backwards, are not common: during fifteen years, Dupuytren has scarcely met with two or three cases; though he has seen some hundreds of lateral dislocation. It must be obvious to every body, says he, that when the foot is violently bent, or extended, many powerful muscles resist the movement in question, and prevent the mischief, with which the articulation is threatened. (*Annuaire Méd. Chir. des Hôpitaux de Paris*, p. 34.) A luxation of the tibia from the astragalus backwards, Sir A. Cooper has never had an opportunity of observing; a proof of the rarity of the accident.

A luxation of the astragalus, either simple, or complicated with a laceration of the integuments, as Mr. Hey has remarked, is an accident which does not often occur. Above, the astragalus is articulated with the tibia and fibula; below, it is united, by means of a capsular ligament, to the os calcis; while, in front, it is connected to the os naviculare by a capsular, and broad internal lateral ligament. Thus situated, it is evident, that its displacement is not likely to happen with great frequency; yet this observation must be received only as a comparative one; for, the cases of dislocation of the astragalus, now upon record, are rather numerous.

When a dislocation of the lower head of the tibia is combined with one of the astragalus from the os calcis, and os naviculare, and the ligaments, which kept these bones together, are nearly destroyed, while a considerable portion of the astragalus itself protrudes through the wound in the integuments, if it be judged prudent to attempt the preservation of the limb, it is best perhaps to imitate Desault, Ferrand, Trye, and Evans, and extract the astragalus altogether.

A luxation of the astragalus, unattended with a wound in the skin, is a serious and embarrassing accident; for, in general, the reduction is so difficult, that it is not many years since the case was deemed a ground for amputation. (See *Gooch's Chir. Cases, &c.*) When the displacement in question happens, the astragalus is generally thrown forwards upon the os naviculare, forming a tumour on the instep, and inclining a little either to the outer or inner side of the foot. In many cases of this description, the reduction is found to be impracticable. Here, as Boyer observes, the impediment does not depend upon the head of the bone being constricted in the narrow opening of the capsule; but rather upon the impossibility of making the extending force, and the pressure of the surgeon's hands, operate with much effect upon the displaced bone. However, an example is recorded by Desault, where the reduction was accomplished by dividing the skin, and then extending the incision through a part of the ligaments. In the *Journ. de Chir.* another case is also related of a simple dislocation of the astragalus from the os calcis, and os naviculare, where the reduction was easily performed by common means. Boyer conceives it probable, that, in these cases, most of the ligaments, uniting the astragalus to the os calcis, and os naviculare were ruptured, and that the first of those bones was therefore sufficiently moveable to admit of being replaced by the pressure of the fingers. But, the luxated astragalus may be so wedged between the tibia, os calcis, and os naviculare, that its reduction is impossible, as Boyer has actually seen. In the case, here referred to, things were left to take their course, except that every possible means was employed to keep off inflammation. The result was, that the skin covering the projection of the astragalus at the inner and upper part of the foot, sloughed, and amputation was at length deemed necessary. (*Mal. Chir.* t. iv. p. 400.) A similar example is recorded by Sir Astley Cooper. (*On Dislocations*, p. 360.) In another case, pressure was made with a tight bandage on the prominence of the astragalus, and the soft parts over it became gangrenous; yet, a recovery followed without amputation, all the projecting portion of the astragalus having gradually come away in fragments. (*Hey's Pract. Obs.* p. 384. ed. 2.) In an instance published, by Dupuytren, a person dislocated the astragalus by alighting with great violence upon the heel, the bone being driven forwards by the pressure which it had sustained between the tibia and os calcis, so as to form a protuberance under the skin of the instep. As the reduction was found impracticable, a cut was made down to the displaced bone, with the intention of extracting it; but, Dupuytren found that he could not remove it so readily as he expected; nor could he replace it; and it was not till after a tedious operation that he succeeded in taking it away. The difficulty arose from the upper surface of the bone being turned downwards, while the back projection of what was naturally the lower part of it took hold of the tibia in the manner of a hook. (*Annuaire Méd. Chir. des Hôpitaux de Paris*, 1819. p. 28.)

In another publication, two cases of dislocation of the astragalus are related. One was a simple luxation of the astragalus inwards, the os calcis, and rest of the foot being thrown outwards. The reduction was easily performed by fixing the knee, then extending the foot gently and directly from the leg, by laying hold of the heel with one hand, and placing the other on the dorsum of the foot; and lastly, by pressing the foot inwards, whilst counter-pressure was made with the knee upon the opposite side of the lower extremity of the tibia. The other instance, alluded to, was a compound luxation, in which the astragalus was displaced outwards, and the other tarsal bones thrown inwards. Reduction was accomplished, first by bending the leg so as to relax the muscles, and then by extending the foot, as above explained, and rotating it outwards. (*Sir A. Cooper, Surgical Essays*, part ii. p. 207.)

Until Mr. B. Phillips recorded two instances of complete dislocation of the astragalus backward, no account of such a displacement had been published. One case happened in a gentleman, who threw himself from a carriage, in consequence of the horses becoming unmanageable, and he alighted on his feet, but immediately fell. A projection presented itself first above the os calcis; the tendo Achillis was pressed backwards by the displaced astragalus; and, at one point, had reached to so near the surface, that vesication was produced directly over it. There was no fracture of the tibia, or fibula; the tibia was slightly displaced forwards upon the foot, and the os calcis retained its natural position. The reduction was found impracticable; but, in the end, an articulation was formed between the bones of the leg and the os calcis, and the patient was able to walk nearly upright. The second example occurred in a gentleman, who, as he was running with great rapidity after a cricket-ball, placed his foot in a gutter. "The toe rested upon the further side of this gutter, while the heel was jammed directly into it, and he fell forward. The appearances were very similar to those of the preceding case. Some attempts at reduction having proved ineffectual, and the foot being much swollen, Mr. Phillips declined to repeat them, and treated the case with leeches, quietude, &c. In the end, scarcely any lameness remained; though at the time when the particulars were written, the patient was obliged to wear a shoe, the hinder part of which was constructed so as not to make pressure on the projecting astragalus. (See *Lond. Med. Gazette*, vol. xiv. p. 596.)

By heavy weights falling upon the foot, a dislocation is sometimes produced at the transverse joint between the astragalus and os calcis behind, and the os naviculare and os cuboides in front.

Sir A. Cooper has twice seen the os cuneiforme internum dislocated, and, in both cases, the head of the bone naturally connected to the os naviculare projected inwards and somewhat upwards, being drawn in this direction by the action of the tibialis anticus muscle. In neither instance was the reduction accomplished; and, in one, the patient had so trivial a lameness, that the functions of the foot were expected to be in time perfect again. (*Surgical Essays*, part ii. p. 209.) With regard to the treatment, Sir Astley Cooper recommends, first, confining the bone in its place with a roller, kept wet with spirits of wine and water, and, when the inflammation is subdued, he directs a leather strap to be buckled round the foot, so as to maintain the bone in its right situation. (*On Dislocations*, p. 384.)

The phalanges of the toes are sometimes dislocated, and the first bone of the great toe is frequently luxated from the first metatarsal bone; but, I am not aware, that these cases are attended with any particular difficulty in the reduction, like some dislocations of the thumb.

On the subject of Dislocations, consult *A. Flach*, de Luxatione Ossis Femoris rariore, frequentiore Colli fractura, Disp. Argent. 1783. *H. Linguet*, Quæstio, &c. An in Humeri Luxatione Ambi potius quam Scala, Janua, Polyspastusque iteratio renovata? Paris, 1732. *G. C. Reichel*, Diss. de Epiphysium ab Ossium Diaphysi Diductione, Lips, 1759. *J. L. Petit*, Traité des Maladies des Os, 1725; et Traité des Mal. Chir. 1783. *Duverney*, Traité des Maladies des Os. *Richerand*, Nosographie Chir. t. 3. p. 193, &c. edit. 4. Œuvres Chir. de Desault, par Biehat, t. i. *Pott*'s Remarks on Fractures and Dislocations, 1775. *Kirkland*'s Obs. upon *Pott*'s General Remarks on Fractures, &c. *White*'s Cases in Surgery. Medical Obs. and Inquiries, vol. ii. *Bromfield*'s Chir. Cases and Obs. 1773. *J. F. P. Castella*, Sur les Fractures du Péroné, Landshut, 1808. Sir *C. Bell*, A System of Operative Surgery, 1809. *J. Howship*, Practical Obs. in Surgery and Morbid Anatomy, 8vo. Lond. 1816, *Callisen*, Systema Chirurgiæ Hodiernæ, t. ii. *Desault*, Journ. de Chirurgie. *Boyer*, Traité des Mal. Chir. t. iv. Paris, 1814. *Trye*'s Illustrations of some of the Injuries to which the lower Limbs are exposed, &c. 4to. Lond. 1802. *Mothe*, Mélanges de Chir. &c. Paris, 1812, 1827. *W. Hey*, On Dislocations and Internal Derangement of the Knee-joint, in Pract. Obs. in Surgery, ed. 2. *Dupuytren*, sur la Fracture de l' Extrémité inférieure du Péroné, les Luxations, et les Accidens, qui en sont la Suite, in Annuaire Medico-Chir. des Hòpitaux de Paris, 1809.; or in Leçons Orales de Clin. Chir. t. i. p. 189. De la Luxation des Vertèbres et des Maladies, qui la simulent, Op. cit. t. i. p. 379.; also des Luxations de l'Humerus, Op. cit. t. iii. p. 77.; De la Luxation Originelle des Fémurs Op. cit. t. iii. p. 205. De la Fracture de l'Extrémité Inférieure de l'Humerus simulant la Luxations du Coude en arrière, Op. cit. t. iii. p. 393. Des Fractures de l'Extrémité Inférieure du Radius simulant les Luxations de Poignet, Op. cit. t. iv. p. 161. Des Luxation de l'Extrémité Inférieure du Cubitus, Op. cit. t. iv. p. 503. *Rust*, in Magaz. für die Gesammte Heilkunde, t. x. *Ph. Crampton*, On the Pathology of Dislocations of Shoulder in Dublin Journ. of Med. Science, No. 7. and 8. Dr. *James Scott*, On Dislocation of Hip, with manner of Reduction and Appearances on Dissection; Dublin Hospital Reports. vol. 3., p. 389. *C. H. Todd*, Dissection after recent Dislocation, Op. cit. vol. iii., p. 395. *Wm. Wallace*, Dissection of a Dislocated Hip, Trans. of King's and Queen's College of Physicians, vol. v., p. 250. *Thos. Wormald*, in Lond. Med. Gaz. for 1836-37. *J. F. Malgaigne*, Gaz. Med. de Paris, 1 Sept. 1832; and in Mém. de l'Acad. Royale de Médécine, t. 5, p. 143. *G. F. D Evans*, on Cataract, Closed Pupil, Amp. at the Shoulder, &c. and Compound Dislocations, 8vo. Wellington, 1815. Astragalus removed; shattered end of the fibula sawn off; protruded lower end of the humerus similarly removed; a compound dislocation of the shoulder-joint, and head of the metacarpal bone of the thumb, dislocated, in two instances, towards the palm, and, on account of the difficulty of reduction, exposed by an incision, and sawn off. Sir *Astley Cooper*, Bart., in Surgical Essays; and Treatise on Dislocations and Fractures of the Joints, a work which abounds in practical information, and does infinite credit to the talents and industry of its experienced author. *J. Cruveilhier*, a spontaneous Dislocation of the first vertebra from the second, and of the occiput; in Anat. Pathol. Livr. 25. Fol. Paris, 1836.

DISTICHIA, or DISTICHIASIS, (from δὶς, twice, and στίχος, a row). A double row of eyelashes, the innermost ones of which irritate the eye. The pseudo-cilia, which grow in distichiasis, seldom occupy the whole length of the eyelid; but are mostly scattered about between the natural place of the cilia and the Meibomian apertures. (See TRICHIASIS.)

DURA MATER, FUNGOUS TUMOURS OF. The disease arises gradually, in the form of a tumour, which makes its way through the bones of the cranium, and insensibly blends itself with the integuments, which seem, as it were, to make a part of it. Fungous tumours of the dura mater may originate spontaneously at any part of this membrane; but they are particularly apt to gro on the surface, which is adherent to the upper part of the skull, or to its basis. They are firm, indolent, and chronic, seeming as if they were the consequence of slow inflammation, affecting the vessels, which supply the dura mater, and inosculate with those of the diploe. It is very difficult to determine, whether the disease begins in the dura mater, or the substance of the bone itself. The general belief, however, is that the bone is affected secondarily, and that the disorder originates in the dura mater. The patient, the subject of the first case, related by M. Louis, imputed the complaint to a fall, which he had met with four or five months previously, and in which the head itself had not received any violence; but, from this time, he experienced a stunning sensation, which continued till he died. The cranium and dura mater were found both equally diseased. Though this case may tend to prove, that fungous tumours of the dura mater may form spontaneously, yet, it is not the less confirmed by a vast number of cases, that this affection more frequently follows blows on the head, than any other cause. Hence, a slow kind of thickening of the dura mater is produced, which ends in a sarcomatous excrescence, the formation of which always precedes the destruction of the bone. In the memoir, published by M. Louis in the fifth volume, 4to. of those of the Royal Academy of Surgery, there is a very interesting case, illustrating the nature of the present disease.

The subject was a young man, aged twenty-one, who had a considerable tumour on the left side of the head, which was taken for a *hernia cerebri*. (See *this Article*.) The swelling had begun in the region of the temple, and had gradually acquired the magnitude of a second head. The external ear was displaced by it, and pushed down as low as the angle of the lower jaw. At the upper part of the circumference of the base of the tumour, the inequalities of the perforated bone, and the pulsations of the brain, could be distinctly felt. Some parts of the mass were elastic and hard; others soft and fluctuating. A plaster, which had been applied, brought on a suppuration at some points, from which an ichorous matter was discharged. Shiverings and febrile symptoms ensued, and the man died in less than four months, in the year 1764. On dissection, a sarcomatous tumour of the dura mater was detected, together with the destruction of the whole portion of the skull, corresponding to the extent of the disease.

When a tumour of this nature has decidedly formed, it makes its way outward through all the parts, soft or hard, which are opposed to it. The swelling, in becoming circumscribed, is partly blended with the dura mater, and its pressure produces an absorption of such parts of the skull, as oppose its enlargement. It unexpectedly elevates itself externally, confounding itself with the scalp, and presents itself outwardly in the form of a preternatural, soft, yielding swelling, which even sometimes betrays an appearance of a decided fluctuation, or a pulsation, which may make it be mistaken for an aneurismal tumour. When once the swelling has made its exit from the cavity of the cranium, it expands on every side under the integuments, which readily make way for its growth. The scalp becomes distended, smooth, and œdematous over the extent of the tumour, and lastly it ulcerates. The matter, discharged from the ulcerations, is thin and sanious: the outer part of the tumour is confounded with the integuments and edges of the skull, on which it rests, so that, in this state, it is easy to mistake the tumour for one, whose base is altogether external. While the swelling thus increases in size externally, it also enlarges internally. The latter change takes place, in particular, while the opening in the cranium is not large enough to admit the whole mass of the tumour, which then depresses the brain, and lodges in an excavation, which it forms for itself. But this cavity quickly diminishes, and becomes reduced almost to nothing, as soon as the tumour projects outwardly. The tables of the skull are absorbed to let the swelling arrive externally; but, it is remarked, that the internal, or vitreous table, is always found much more extensively destroyed, than the external one. Sometimes, new bony matter is found deposited around the opening in the cranium.

It is asserted, that, whatever may be the situation of a fungous tumour of the dura mater, the outer layer of this membrane, upon which the disease forms, is alone altered, the inner layer and the pia mater being always unchanged. (*Lassus, Pathologie Chirurgicale,* tom. i. p. 501. éd. 1809.)

In one of these cases, detailed by Walther, the inner layer of the dura mater was quite natural, though one-half of the tumour, which was large, was within the skull, where it had formed for itself a deep excavation in the posterior lobe of the brain. And, what is remarkable, notwithstanding this latter change, the patient, the day before her death, retained all her intellectual faculties, and the power of voluntary motion. (*Journ. für Chirurgie von C. Graefe und Ph. v. Walther*, b. i. pp. 64, 65., 8vo. Berlin, 1820.)

According to surgical writers, fungous tumours of the dura mater have been caused by contusions on the skull, falls on the buttocks, concussions of the head or whole body, lues venerea, scrofula, inveterate rheumatism, &c. The three last of the alleged causes, however, seem to be little better than mere conjecture.

Even children of the most tender years are liable to the disease. M. Louis has related, that a child, two years of age, died of a fungous of the dura mater, which had produced a swelling above the right ear, attended with a destruction of a portion of the parietal and temporal bones. (*Mém. de l'Acad. de Chirurgie*, tom. v. 4to. p. 31.)

Though the common opinion is, that these fungi grow entirely from the dura mater, Sandifort asserts, that the vessels of the diploe have a considerable share in their production. (*Descriptio Musei Anat. Acad. Lugd.* t. i. p. 152.)

A similar belief was entertained by Heister and Kaufmann, and is espoused by Siebold and Walther, the latter imputing the disease to a simultaneous affection of the vessels of the dura mater, and pericranium, attended with an absorption of the earthy part of the bone. (*Journ. für Chir. von C. Graefe, &c.* p. 91—93.) M. Chelius has written an essay, in which a distinction is established between tumours commencing in the bone, and others beginning in the dura mater itself. (See *Archives de Méd.*; Mars, 1832.)

The existence of a fungous tumour of the dura mater cannot be ascertained, so long as there is no external change. The effects, produced, may originate from so many causes, that there would be great risk of a gross mistake in referring them to any particular ones. This is not the case, when there is an opening in the skull. Then a hardness, felt from the very first at the circumference of the tumour, denotes that it comes from within. When the swelling is carefully handled, such a crackling sensation is perceived, as would arise from touching dry parchment stretched over the skin. On making much pressure, pain is occasioned, and sometimes a numbness in all the limbs, stupefaction and other more or less afflicting symptoms. The tumour, in some measure returns inward, *especially, when not very large*, and gradually rises up and outward again, when the pressure is discontinued. Sometimes there is pain; at other times, there is none; which may be owing to the manner, in which the tumour is affected by the edges of the bone, through which it passes. The pain is often made to go off by compression, but returns as soon as this is taken off. The tumour has an alternate motion, derived from the pulsation of the brain, or of the large arteries at its base. This throbbing motion has led many practitioners to mistake the disease for an aneurism, as happened in the second case, related in the memoir of M. Louis. When the tumour is pushed sideways, and the finger carried between it and the edge of the bone, through which the disease protrudes, the bony edge may be felt, touching the base of the swelling, and more or less constricting it. This symptom, when distinguishable, added to a certain hardness and elasticity, and sometimes a facility of reduction, forms a pathognomonic mark, whereby fungous tumours of the dura mater may be discriminated from herniæ of the brain, external fleshy tumours, abscesses, exostosis, and other affections, which at first sight resemble them.

Probably, however, some variety prevails in different instances; for, in the cases recorded by Walther, there was no pulsation, strictly so called, but merely an obscure movement, or an alternate distension and flaccidity, arising from the influx of blood into the vessels of the diseased mass; the tumours could not be pushed within the cranium in the slightest degree; nor did the attempt cause any of the effects usually observed to proceed from pressure on the brain. No aperture could be felt in the skull, much less could the irregular edges of the bone around the tumour be distinguished. (*Journ. für Chir.* b. i. p. 57—61, &c. 8vo. Berlin, 1820.)

Whatever movements also were perceptible in the swellings, Walther is convinced could not be communicated to them by the pulsations of the subjacent brain; because they were wedged, as it were, in an aperture in the skull, and adherent to the dura mater beneath them, and to the superincumbent periosteum, so that, even in the dead subject, they did not admit of being pushed in the least outwards without difficulty, and the employment of strong pressure. (Vol. cit. p. 57.)

Indeed, this tight constriction of the tumour not only explains why stupor, paralysis, &c. were not brought on in these particular examples by external pressure, but also why the edges of the hole in the skull could not be felt; and the small size of the same opening, in relation to the magnitude of the swelling, fully accounts in my opinion for the circumstance of the swelling not sinking inwards under pressure. But, I am far from being convinced with Walther, that fungi of the dura mater are in their nature always irreducible (see vol. cit. p. 82.); a belief, which he grounds upon the connection of the diseased mass with the vessels of the diploe; its constriction by the bone; and its expansion under, as well as above, the cranium. Here I think Walther is as wrong in saying, that none of these fungi can possibly be reduced, as others would be in asserting that it is their invariable character to be reducible. These differences must chiefly depend upon the size of the swelling, in relation to that of the aperture in the skull.

Generally speaking, fungous tumours of the dura mater are very dangerous, as well on account of their nature, as of the difficulty of curing them in any certain manner, and of the internal and external disorder, which they may occasion. Such as have a pedicle, the base of which is not extensive; which are firm in their texture, without much disease in the surrounding bone, are moveable, not very painful, and in persons, who are in other respects quite well, are in general reputed to be the least perilous. These are the cases, in which a cure may be attempted, with a hope of success, though the event is always exceedingly doubtful.

When the contrary of what has been just related occurs, when the disease is of long continuance, and the brain already affected, nothing favourable can be expected.

Compression is the most simple means of cure, and that which has naturally occurred to such practitioners, as have mistaken the disease for an aneurism, or a hernia cerebri. The efficacy of this method has been further misconceived, because the tumour, when not very large, has sometimes been partly, or even wholly reduced, without any bad consequences. This had no little share in leading to errors, concerning the true character of the disease. But, as might be conceived, this reduction only being attended with temporary success, and having no effect whatever on the original cause of the affection, the symptoms returned, and the tumour rose up again, the moment the compression was discontinued. There is a fact in the memoir of M. Louis, which seems to evince, that good effects may sometimes be produced by compression judiciously employed. A woman, brought to the brink of the grave by the symptoms, occasioned by a tumour of the above kind, having rested with her head, for some time, on the same side as the tumour, found the swelling so suddenly reduced, without any ill effects, that she thought herself cured by some miracle. Compression artfully kept up, by means of a piece of tin, fastened to her cap, prevented the protrusion of the tumour again. The pressure, however, not having been always very exact, the symptoms every now and then recurred, while the tumour was in the act of being depressed again, and they afterwards ceased, on the swelling having assumed a suitable position. The symptoms were, doubtless, occasioned by the irritation, which the tumour suffered, in passing the inequalities around the opening, through which it protruded. The patient lived in this state nine years, having every now and then fits of insensibility, in one of which, attended with hiccough and vomiting, she perished.

As compression cannot be depended upon, the following safer method may be tried:—It consists in exposing the tumour with a knife, which is certainly preferable to caustics, the action of which is very tedious and painful, and can never be limited or extended with any degree of precision. A crucial incision may be made through the scalp covering the tumour, and the flaps dissected up, and reflected, so as to bring all the bony circumference into view. Then with trephines repeatedly applied, or with what would be better, Mr. Hey's saws, all the margin of the bone should be carefully removed. Now, if it be true, that the vessels of the diploe are chiefly concerned in the supply of the diseased mass, we see that this source of its growth must be destroyed by the foregoing proceeding.

The tumour, thus disengaged on all sides, may be cut off with a scalpel; and such arteries as bleed much should be tied. Then, instead of applying caustic, as sometimes advised, perhaps, it would be better to remove every part of both layers of the dura mater immediately under the situation of the excrescence. By this means, and the removal of the surrounding bone and diploe, all chance of the regeneration of the tumour would be prevented. In attempting the excision of a fungous of the dura mater, it is certainly an interesting point to know, whether the tumour has an intimate vascular connection with the diploe, and pericranium, as asserted by Siebold, Walther, and some other respectable authorities; though the importance of the information on this subject to the practitioner is somewhat lessened by his being aware, that it is necessary always to begin with sawing away the bone in the immediate vicinity of the diseased mass. In the dissection of one case, Walther found the pericranium thickened for a considerable extent around the disease, and closely connected with the tumour by vessels. (Vol. cit. p. 100.)

When the tumour is sarcomatous, and its pedicle small and narrow, as sometimes happens, one should not hesitate to cut it off.

This method is preferable to tying its base with a ligature; a plan which could not be executed, without dragging, and seriously injuring the dura mater; and the fatal effects of which I saw exemplified in one case that occurred many years ago in

St. Bartholomew's Hospital, and was operated upon by the late Mr. Ramsden. Excision is also preferable to caustics, which cause great pain, and very often convulsions. In performing the extirpation, we should remove the whole extent of the tumour, and, if possible, its root, even though it may extend as deeply as the internal layer of the dura mater. This step must not be delayed, for the disease will continue to increase, so as to affect the brain, become incurable, and even mortal. It is to such decision, that we must impute the success, which attended the treatment of the Spaniard Avalos, of whom Marcus Aurelius Severinus makes mention. The above nobleman was afflicted with intolerable headachs, which no remedy could appease. It was proposed to him to trepan the cranium, an operation to which he consented, This proceeding brought into view, under the bone, a fungous excrescence, the destruction of which proved a permanent cure of the violent pains, which the disease had occasioned. It is not mentioned in this case, whether the internal layer of the dura mater was healthy, or not; but there is foundation for believing, that if the extirpation of these tumours be undertaken in time, and bold measures be pursued, as in the instance just cited, success would often be obtained. Indeed, reason would support this opinion; for, when the disease is not extensive, it is necessary to expose a much smaller surface of the dura mater.

It appears to me, however, that trepanning can never be warrantable, unless the disease be indicated by some external changes. I saw my late master, Mr. Ramsden, trepan a man for a mere fixed pain in one part of the head, on the supposition, that there was a tumour under the bone; but no tumour was found, and the operation caused inflammation of the dura mater, and proved fatal.

No doubt, in some cases, the hemorrhage will be considerable, as was exemplified in the instance in which Walther made an incision at the base of one of these fungi, in order to ascertain its nature: two pints of blood being lost from several vessels of large size ere they could be secured; and the further use of the knife discontinued.

M. Louis has described other tumours, which grow from the surface of the dura mater, when this membrane has been denuded, as after the application of the trephine. They only seem to differ from the preceding in not existing, before the opening was made in the skull. Tumours of the dura mater should not be confounded with hernia cerebri. (See *this Article.*)

See, on the preceding subject, Mém. sur les Tumeurs, fongueuses de la Dure-Mère, par *M. Louis*, in Mém. de l'Acad. de Chir. t. v. 4to. Encyclopédie Méthodique, Partie Chir. art. Dure-Mère. *J. P. Kaufmann*, de Tumore Capitis fungoso post Cariem Cranii exorto. Helmst. 1743. *Lassus*, Pathologie Chir, t. 1. p. 497. ed. 1809. *J.* and *C. Wenzel*, über die Schwammigen Auswuchse auf der aussern Hirnhaut. Fol. Mainz. 1811. Ph. v. *Walther*, in Journ. für Chir. von *C. Graefe*, &c. b. 1. p. 55. c. 8vo. Berlin, 1820. Professor *Chelius*, in Archives de Méd. Mars, 1832.

For inflammation of the dura mater, see HEAD, INJURIES OF.

DYNAMOMETER. An instrument, employed by M. Malgaigne for measuring the degree of extension made with pulleys in the reduction of dislocations. (See *Mém. de l'Acad. R. de Méd.* t. v. p. 143.) It will serve also to measure the force exerted in lithotrity.

EAR, DISEASES OF.

An organ, so valuable and necessary to the perfection of our existence, as the ear, should have all the resources of surgery exerted for the preservation of its integrity, and the removal of the diseases, with which it may be affected. What, indeed, would have been our lot, if nature had been less liberal, and not endued us with the sense of hearing? As Leschevin has observed, we should then have been ill qualified for the receipt of instruction; a principal inlet of divine and human knowledge would have been closed; and there being no reciprocal communication of ideas, our feeble reason could never have approached perfection. Even our life itself being as it were dependent upon all such bodies as surround us, would have been incessantly exposed to dangers. The eyesight serves to render us conscious of objects, which present themselves before us, and, when we judge them to be hurtful, we endeavour to avoid them. But, to say nothing of our inability to look on all sides at once, our eyes become of no service to us, whenever we happen to be enveloped in darkness. The hearing is then the only sense, that watches over our safety. It warns us, not only of every thing, which is moving about us, but likewise of noises, which are more or less distant. Such are the inestimable advantages, which we derive from this organ. Its importance, when healthy, makes it worthy of the utmost efforts of surgery, when diseased. (See *Méd. sur les Sujets proposés pour le Prix de l'Acad. Royale de Chirurgie*, t. ix. pp. 111, 112. éd. 12mo.)

It is not many years since the diseases of the ear were a subject, on which the greatest ignorance and the most mistaken opinions prevailed; and, indeed, how could any correct pathological information be expected, while anatomists had not given a complete and accurate description of the organ itself? Also, notwithstanding what has now been made out, respecting disorders of the ear, it is generally admitted, that they still require much further investigation. Though Duverney, Valsalva, Morgagni, &c. dispelled some of the darkness, which covered this branch of surgery, they left a great deal undone. Since their time, science has been enriched with the valuable discoveries of Cotunni, Meckel, Scarpa, and Comparetti; the two first of whom demonstrated, that the labyrinth is filled with a limpid fluid, and not (as was pretended) with confined air; while the two last distinguished anatomists favoured the public with the first very accurate description of the parts composing the labyrinth, especially, the semicircular canals.

In 1763, the French Academy of Surgery offered a prize for the best essay on diseases of the ear, and two years afterwards, the honour was adjudged to that of Leschevin, senior surgeon of the hospital at Rouen. This memoir is still of great value, few modern treatises being more complete. The most useful contributors to our stock of information on the pathology of the ear, subsequently to M. Leschevin, have been Kritter, and Lenten (*Ueber das schwere Gehoer*, Leipz. 1794); Trampel (*Arnemann's Magaz.* b. ii. 1798); Pfingsten (*Vieljahrige Erfahrung ueber die Gehoerfehler*, Kiel, 1802); Alard (*Sur le Catarrhe de l'Oreille*, 8vo. Paris, 1807, édit. 2.); Sir A. Cooper (*Phil. Trans.* 1802); Portal (*Anat. Méd.*

1803); J. C. Saunders (*Anat. and Dis. of the Ear*, 1806); Boyer (*Mal. Chir.* t. vi.); Itard (*Traité des Mal. de l'Oreille*, 8vo. 2 tomes); Saissy, in an essay, which received the approbation of the Medical Society of Bourdeaux; Rosenthal in a short, but sensible tract on the pathology of the ear (see *Journ. Complém.* t. vi. 1820); and Krämer in a treatise recently published.

But, notwithstanding the laudable endeavours of so many men of eminence, the pathology of the internal ear, and the treatment of its diseases, are far, I may say, very far from a high state of improvement. To further advances, indeed, some discouraging obstacles present themselves: the auditory apparatus is extremely complicated; the most important parts of it are entirely out of the reach of ocular inspection; the anatomy of the organ is perhaps not yet completely unravelled; the exact uses and action of several parts of it, anatomically known, are still involved in mystery; the opportunities of dissecting the ear in a state of disease are neither frequent, nor duly watched; and even when they are taken, and when vestiges of disease, or imperfection are traced to particular parts of the organ, the utmost difficulty is experienced in drawing any useful practical conclusion, because the natural uses of those parts, and the precise manner in which they contribute to the perfection of the ear are not known to the most enlightened physiologists. We are here nearly in the same helpless dilemma as a watchmaker would be, were he in examining the interior of a watch, to find parts broken and out of order, the exact uses of which, in the perfection of the instrument, he had not first studied and comprehended. In fact, the physiology of the ear is but imperfectly understood; and, as Rosenthal remarks (*Journ. Complém.* t. vi. p. 17.) if, notwithstanding the progress made in optics, and the complete knowledge of the structure of the eye, a perfect explanation has not yet been given of the phenomena of this organ, as an instrument of vision, we cannot wonder, that, with far more circumscribed information about acoustics, and the greater difficulty of unravelling the structure of the ear, so little progress should have been made in the physiology of the latter organ. Were it practicable in acoustics to arrive at that precision and certainty, which would enable us to establish laws in the theory of sound, as fixed as those which relate to light, this void in physiological science might perhaps be obviated. But, Rosenthal justly argues, that hitherto the approach to perfection has not been made, and this notwithstanding the learned and valuable labours of Chladni. (*Akustik.* 4to. Leipz. 1802.) Some facts, however, are admitted to be well ascertained, and the researches of Autenrieth and Kerner (*Reil's Archiv. für die Physiol.* t. ix. p. 313—376.) are honourably mentioned; for, though they only elucidate the function of the conductor part of the ear, they are of unquestionable importance to the medical practitioner. It is clearly proved, that the difference in the length and breadth of the meatus auditorius, the form of the membrana tympani, and the make of the cavity of the tympanum, modify sound; that is to say, that the differences of structure of the auricle and meatus auditorius externus which merely receive and concentrate the sonorous undulations, as these emanate from a vibrating body, can only influence the degree of orce, or weakness of the sound; while, on the contrary, the differences of structure in the membrane and cavity of the tympanum are not limited to this effect, but the greater or less tension of the one, and the more or less considerable capacity of the other, appear to alter in a greater or lesser degree the particular character of the sound. (*Journal Complém.* t. vi. p. 20.)

1. *Wounds and Defects of the external Ear.*

The external ear, which is a sort of instrument calculated for concentrating the undulations or waves of sound, may be totally cut off, without deafness being the consequence. For a few days after the loss, the hearing is rather hard; but the infirmity gradually diminishes, the increased sensibility of the auditory nerve compensating for the imperfection of the organic apparatus. (*Richerand, Nosogr. Chir.* t. ii. p. 122. éd. 2.)

Dr. Hennen says, that he has met with a case, where the external ear was completely removed by a cannon-shot, and yet the sense of hearing was as acute as ever. (*Principles of Military Surgery*, p. 348. éd. 2.) Another case, recorded by Wepfer, also proves, that a total loss of the auricle may not cause any material injury of hearing, for the patient of whom he speaks had had the whole of the external ear destroyed by ulceration, and yet could hear as well as before the loss. (*Kritter und Lentin über das schwere Gehoer*, p. 19. Leipz. 1794.) However, if we are to credit the statement of other writers, the recovery is generally far less complete. Thus Leschevin notices, that they who have lost the external ear, or have it naturally too flat, or ill-shaped, have the hearing less fine. The defect can only be remedied by an artificial ear, or an ear-trumpet, which, receiving a large quantity of the sonorous undulations, and directing them towards the meatus auditorius, thus does the office of the external ear. (*Prix de l'Acad. Royale de Chir.* t. ix. p. 120. édit. 12mo.)

Wounds are not the only causes, by which the external ear may be lost: its separation is sometimes the consequence of ulceration, and sometimes the effect of the bites of horses and other animals. In cold climates, it is frequently frozen, and afterwards attacked with inflammation and sloughing. When the external ear is not totally separated from the head, the surgeon should not despair of being able to accomplish the reunion of it. This attempt should always be made, however small a connection the part may have with the skin; for, in wounds of this kind, the efforts of surgery have occasionally succeeded beyond all expectation.

Wounds of the external ear, whatever may be their size and shape, do not require different treatment from that of the generality of other wounds. The reunion of the divided part is the only indication, and it may be in most instances easily fulfilled by means of methodical dressings. Such writers, as have recommended sutures for wounds of the ear (says Leschevin), have founded this advice upon the difficulty of applying to the part a bandage, that will keep the edges of the wound exactly together. The cranium, however, affords a firm and equal surface, against which the external ear may be conveniently fixed. Certainly, it is not more easy to secure dressings on the nose than the ear; and yet cases are recorded, in which the cartilaginous part of the nose was wounded, and almost entirely separated, and the union was effected without the aid of sutures. (See *Mém. de M. Pibrac sur l'Abus des Sutures, in Mém. de l'Acad. de Chir.* tom. iii.)

In wounds of the ear, then, we may conclude, that sutures are generally useless and unnecessary. As examples may occur, however, in which the wound may be so irregular and considerable as not to admit of being accurately united, except by this means, it should not be absolutely rejected. An enlightened surgeon will not abandon altogether any curative plans; he only points out their proper utility, and keeps them within their right limits. When sticking plaster, simple dressings, and a bandage that makes moderate pressure, appear insufficient for keeping the edges of a wound of the ear in due contact, the judicious practitioner will not hesitate to employ sutures.

When a bandage is applied to the external ear, it should only be put on with moderate tightness, since much pressure gives considerable uneasiness, and may induce sloughing. In order to prevent these disagreeable effects, Leschevin advises us to fill the space behind the ear with soft wool or cotton, against which the part may be compressed without risk. (*Op.* cit. p. 119.)

Baron Boyer remembers a medical student, who was compelled by an ulcer on the sacrum to lie for a long time on his side, in which posture the pressure on the ear caused a slough of the antihelix, and after the separation of the dead part, an aperture, large enough to receive the end of the little finger, was left in the pinna or auricle.

In the application of sutures to the ear, the ancients caution us to avoid carefully the cartilage, and to sew only the skin. They were fearful, that pricking the cartilage would make it mortify, "*ce qui est souvente-fois arrivé,*" says Paré. But, notwithstanding so respectable an authority, as Leschevin has remarked, the moderns make no scruple about sewing cartilages. In wounds of the nose, Verduc expressly directs the skin and cartilage to be pierced at once, and the success of the plan is put out of all doubt by a multitude of facts. The same treatment may also be safely extended to the ear.

In this section, a few malformations of the external ear require notice. Sometimes the orifice of the meatus auditorius is diminished by the tragus, antitragus, and antihelix being depressed into it. Here the excision of these wrongly formed eminences has been recommended, as a surer means of perfecting the sense of hearing, than the use of any tube, or dilating instruments. The tragus has been known to project considerably backwards, and to apply itself most closely over the orifice of the meatus, which was also a mere slit, instead of a round opening. In one case of this description, relief was obtained by the introduction of tubes, calculated to maintain the tragus in its proper position. (*Dict des Sciences Méd.* t. xxxviii. p. 28.)

Sometimes the outer ear is entirely wanting. Thus Fritelli has given an account of a child in this condition, whose physiognomy at the same time strongly resembled that of an ape. (*Orteschi Giorn. di Med.* t. iii. p. 80.) Oberteuffer has also recorded an example of a total deficiency of the auricles in an adult, who yet heard very well. (*Stark's Neues Archiv.* b. ii. p. 638.) *J. F. Meckel, Handbuch der Pathol. Anat.* b. i. p. 400. Leipz. 1812.)

I remember a child, which was exhibited many years ago in London, as a curiosity; it was entirely destitute of external ears, and no vestiges of the meatus auditorii could be seen, these openings being completely covered by the common integuments. Yet the child could hear a great deal, though the sense was certainly dull and imperfect. I recollect, that the circumstance of the patient hearing so well as he did, was what excited considerable surprise. I do not recollect, however, at the present time, the degree in which this sense was enjoyed, and several other circumstances, such as the child's age, power of speech, &c. The example is interesting, inasmuch as it proves, that even a deficiency of the auricles, combined with an imperforate condition of both ears, may be unattended with complete deafness, provided the internal and more essential parts of these organs are sound and perfectly formed.

Baron Boyer attended a young man, the lobule of one of whose ears extended in a very inconvenient manner over the cheek: the redundant portion was removed with a pair of scissors, and the wound soon healed.

The auricle, not being a very irritable part, is not often inflamed, and when it is so, the affection is generally of an erysipelatous character. Portal has seen the part nearly an inch thick; and he takes notice of the prodigious thickness, which the lobe of the ear sometimes acquires in women who wear heavy ear-rings, which keep up constant irritation. Small encysted and adipose swellings occasionally grow under the skin of the external ear, and demand the same treatment as swellings of the same nature in other situations. (See Tumours.) Lastly, the external ear is frequently the seat of scrofulous, and other ill-conditioned ulcers. These cases generally require cleanliness, alterative medicines, and to be dressed with the ung. zinci, or the ung. hydrarg. nitrat. or a solution of the nitrate of silver; and sometimes, when the sores resist for a long time the effects of medicine and the usual dressings, they will soon heal up, if the treatment be assisted with a blister, or seton, kept open on the nape of the neck. (See *Dict. des Sciences Méd.* t. xxxviii. p. 28, 29.)

2. *Of the Meatus Auditorius, and its Imperfections.*

This is the passage, which leads from the cavity of the external ear, called the concha, down to the membrane of the tympanum. It is partly cartilaginous, and partly bony, and has an oblique winding direction, so that its whole extent cannot be easily seen. There are circumstances, however, in which it is proper to look as far as possible into the passage. Such is the case, when the surgeon is to extract any foreign body, to remove an excrescence, or to detect any other occasion of deafness. Fabricius Hildanus gives a piece of advice upon this subject, not to be despised; namely, to expose the ear to the rays of the sun, in order to be enabled to see the very bottom of the passage.

Mr. Buchanan recommends the patient to be placed upon a low seat, with the ear exposed to the rays of the sun. The surgeon should then lay hold of the auricle with the left hand, by placing the thumb in the concha, and with the index and middle finger of the same hand placed behind the cartilage, take hold of the cavity, and pull it outwards and upwards, so as to elongate the cartilaginous part of the meatus. With the help of a slightly curved probe, by which the tragus is to be drawn a little outwards, and the diameter of the tube increased, the whole of the meatus and membrana tympani may then be distinctly seen. (See *Buchanan's Illustrations of Acoustic Surgery*, p. i.) When the assistance of sunshine cannot be obtained, and in the evening, Mr. Buchanan finds great advantage from the use of an ingenious kind of lantern, which he has invented for examining the ear, and which he terms an inspector auris. When it is used, the room is darkened, and the focus from the lantern directed into the meatus.

The surgical operations, practised on the meatus auditorius, are confined to opening it, when preternaturally closed, extracting foreign bodies, washing the passage out with injections, and removing excrescences.

The case which we shall next treat of, is the imperforation of the meatus auditorius externus, a defect with which some children are born.

When the malformation exists in both ears, it generally renders the subject dumb, as well as deaf, for, as he is incapable of imitating sounds, which he does not hear, he cannot of course learn to speak, although the organs of speech may be perfect, and in every respect rightly disposed. In this case, the surgeon has to rectify the error of nature, and (to use the language of Leschevin) he has to give, by a double miracle, hearing and speech to an animated being, who, deprived of these two faculties, can scarcely be regarded in society as one of the human race. How highly must such an operation raise the utility and excellence of surgery in the estimation of the world!

When the meatus auditorius externus is merely closed by an external membrane, the nature of the case is evident, and the mode of relief equally easy. But, when the membrane is more deeply situated in the passage, near the tympanum, the diagnosis is attended with increased difficulty, and the treatment with greater trouble.

If the preternatural membrane be external, or only a little way within the passage, it is to be divided with a bistoury; the small flaps are to be cut away; a tent, of a suitable size, is to be introduced into the opening; and the wound is to be healed *secundum artem*, care being taken to keep it constantly dilated, until the cicatrisation is completed.

When the obstruction is deeply situated, we must first be sure of its existence, which is never ascertained, or even suspected, till after a long while. It is not till after children are past the age, at which they usually begin to talk, that any defect is suspected in the organ of hearing, because, until this period, little notice is taken, whether they hear or not. As soon as it is clear, that this sense is deficient, the ears should always be examined with great attention, in order to discover, if possible, the cause of deafness. Sometimes, the infirmity depends upon a malformation of the internal ear, and the cause does not then admit of detection. The most convenient method of making the examination is to expose the ear, which is about to be examined, to the light of the sun. In this situation, the surgeon will be able to see beyond the middle of the bony part of the meatus, if he places his eye opposite the orifice of the passage, and takes care to efface the curvature of the cartilaginous portion of the canal, by drawing upward the external ear. If the passage has been carefully cleansed, before the examination, the skin, forming the obstruction, may now be seen, unless it be immediately adherent to the tympanum.

When the preternatural septum is not closely united to the tympanum, its destruction should be attempted, and hopes of effecting the object, either suddenly or gradually, may reasonably be entertained. According to Leschevin, the particular situation of the obstruction is the circumstance, by which the surgeon ought to be guided in making a choice of the means for this operation. If the membranous partition is so far from the tympanum, that it can be pierced without danger of wounding the latter part, there can be no hesitation in choosing the plan to be adopted. In the contrary state of things, Leschevin is an advocate for the employment of caustic, not only on account of the risk of injuring the tympanum with a cutting instrument, but, also, because, if the puncture were ever so well executed, a tent could not be introduced into it, so as to prevent it from closing again.

In the first case, a very narrow sharp-pointed bistoury should be used: after its blade has been wrapped round with a bit of tape to within a line of the point, it is to be passed perpendicularly down to the preternatural membrane, which is to be cut through its whole diameter. The instrument being then directed first towards one side, then the other, the crucial incision is to be completed. As the flaps, which are small and deeply situated, cannot be removed, the surgeon must be content with keeping them separated by means of a blunt tent. The wound will heal just as favourably as that occasioned in removing the imperforation of the concha, or outer part of the meatus auditorius. (*Prix de l'Acad. de Chir.* p. 124—126. t. ix.) In the second case, that is to say, when the risk of wounding the tympanum leads us to prefer the employment of caustic, the safest and most commodious way of putting the plan in execution would be that of touching the obstruction, as often as circumstances may require, with the extremity of a bougie armed with the argentum nitratum. In the intervals of the applications, no dressings need be introduced, except a bit of clean soft cotton, for the purpose of absorbing any discharge which may take place within the passage.

It is manifest, that if the whole, or a considerable part of the meatus auditorius externus were wanting, the foregoing measures would be insufficient. The following observations of Leschevin merit attention:—"I do not here allude to cases, in which a malformation of the bone exists. I know not, whether there are any examples of such an imperforation; but, it is clear, that it would be absolutely incurable. I speak of a temporal bone perfectly formed in all its parts, and the meatus auditorius of which, instead of being merely lined by a membrane, as in the natural state, is blocked up by the cohesion of the parietes of this membrane throughout a certain extent of the canal; just as the urethra, rectum, or vagina, is sometimes observed to be not simply closed by a membrane, but by a true obliteration of its cavity.

"Such a defect in the ear may be congenital, and it may also arise from a wound, or ulceration, of the whole circumference of the meatus auditorius externus, this canal having become closed by the adhesion of its parietes, on cicatrisation taking place.

"Such an imperforation, whether congenital or accidental, must certainly be more difficult to cure than the examples treated of above; but," says Leschevin, "I do not for this reason believe, that the case ought to be entirely abandoned. Yet, I would not have the cure attempted in all sorts of circumstances. For instance, if the defect only existed in one ear, and the other were sound, I would not undertake the operation, because, as the patient could hear tolerably well on one side, the advantages which he might derive from having the enjoyment of the other ear, would not counterbalance the pain and bad symptoms occasioned by such an experiment, the success of which is extremely uncertain. I would not then run the risk of making a perforation, except in a case of complete deafness; and I propose this means only as a dubious one, upon the fundamental maxim, so often laid down, that it is preferable to employ a doubtful remedy, than none at all.

"With respect to the mode of executing this operation," says Leschevin, "the trocar seems the most eligible instrument. I would employ one, that is very short, and the point of which is bluntish, and only projects out of a cannula as little as possible. This construction would indeed make the instrument less adapted to pierce any thing; but, still, as the parts to be perforated are firm, their division might be accomplished sufficiently well; and the inconvenience of a trivial difficulty in the introduction of the trocar is comparatively much less than that which would attend the danger of wounding with a sharper point the membrane of the tympanum. I would plunge the point of the instrument into the place, where the opening of the meatus auditorius externally ought naturally to be, and which would be denoted, either by a slight depression, or at all events by attending to the different parts of the ear, especially the tragus, which is situated directly over this passage. I would push in the trocar gently, in the direction of the canal formed in the bone, until the point of the instrument felt as if it had reached a vacant space. Then, withdrawing the trocar, and leaving the cannula, I would try, whether the patient could hear. I would then introduce into the cavity of the cannula itself a small, rather firm tent, of the length of the passage, or a small bougie. By means of a probe, I would push it to the end of the cannula, which I would now take out, observing to press upon the tent, which is to be left in. The rest of the treatment consists in keeping the canal pervious, making it suppurate, and healing it with common applications. One essential caution, however, would be that of keeping the part dilated long after it had healed: otherwise, it might close again, and a repetition of the operation become necessary. This happened to Heister, as he himself apprises us, and it occurred to Roonhuysen in treating imperforations of the vagina.

"If the cohesion of the parietes of the meatus auditorius externus were to extend to the tympanum inclusively, the operation would be fruitless; but, as it is impossible to ascertain this circumstance, before the attempt is made, the surgeon would incur no disgrace by relinquishing the operation, and giving up the treatment of an incurable disease. If, then, after the trocar were introduced to about the depth of the tympanum, the situation of which must be judged of by our anatomical knowledge, no cavity were met with, the operation should be abandoned; and if, in these circumstances, any one were to impute the want of success to the inefficacy of surgery, or the unskilfulness of the surgeon, he would act very unfairly.

"It is also plain, that such an operation could cure a congenital deafness, only inasmuch as it might depend upon the imperforation; for, if there should exist, at the same time, in the internal ear, any malformation, destructive of the power of the organ, the remedying of the external defect would be quite useless." (*Leschevin, in Prix de l'Acad. de Chirurgie*, tom. ix. p. 127—132.)

We find, that this author entertains a great dread of wounding the tympanum, and certainly he is right in generally insisting upon the prudence of avoiding such an accident. It will appear, however, in the sequel of this article, that under certain circumstances, puncturing the tympanum has been successfully practised as a mode of remedying deafness. The operation, however, demands caution; for, if done so as to injure the connection of the malleus with the membrana tympani, the hearing must ever afterwards be very imperfect.

3. *Unusual Smallness of the Meatus Auditorius Externus.*

Imperforation is not the only congenital imperfection of the meatus auditorius; this passage is occasionally too narrow for the admission of a due quantity of the sonorous undulations, and the sense is of course weakened. Leschevin mentions that M. de La Metrie found this canal so narrow in a young person, that it could hardly admit a probe. What has been observed concerning the imperforation, is also applicable to this case. If it depends upon malformation of the bone, it is manifestly incurable; but, if it is owing to a thickening of the soft parts, within the meatus, hopes may be indulged of doing good by gradually dilating the passage with tents, which should be increased in size from time to time, and, lastly, making the patient wear, for a considerable time, a tube, adapted to the part in shape. (*Leschevin, in Prix de l'Acad. de Chirurgie*, t. ix. p. 132.)

Mr. Earle has published a case, in which the diameter of the meatus auditorius was considerably lessened by a thickening of the surrounding parts, and especially of the cuticle, attended with a discharge from the passage, and great impairment of hearing. A cure was effected by injecting into the passage a very strong solution of the nitrate of silver, which, in a few days, was followed by a detachment of the thickened portions of cuticle. This evacuation was assisted by throwing warm water into the passage. (See *Med. Chir. Trans.* vol. x. p. 411, &c.) Boyer was consulted for a deafness, arising from a malformation, which consisted of a flattening of the meatus, its opposite sides being for some extent in contact. The patient was advised to wear in the ear a gold tube of suitable shape, by which means he was enabled to hear perfectly well.

4. *Faulty Shape of the Meatus Auditorius Externus.*

Anatomy informs us, that this passage is naturally oblique, and somewhat winding; and natural philosophy teaches us the necessity of such obliquity, which multiplies the reflections of the sonorous waves, and thereby strengthens the sense. This theory, says Leschevin, is confirmed by experience; for, there are persons, in whom the meatus auditorius is almost straight, and they are found to be hard of hearing. If there is any means of correcting this defect, it must be that of substituting, for the natural curvature of the passage, a curved and conical tube, which must be placed at the outside of the organ, just like a hearing trumpet. The acoustic instrument, invented by Deckers, which is much more convenient, might also prove useful. (*Op.* cit. p. 133.)

5. *Extraneous Substances, Insects, &c. in the Meatus Auditorius Externus.*

Foreign bodies met with in this situation are inert substances, which have been introduced by some external force; insects, which have insinuated themselves into the passage; or the cerumen itself, hardened in such a degree, as to obstruct the transmission of the sonorous undulations. Worms, which make their appearance in the meatus auditorius, are always produced subsequently to ulcerations in the passage, or in the interior of the tympanum, and very often such insects are quite unsuspected causes of particular symptoms. In the cases of surgery, published in 1778, by Acrel, there is an instance confirming the statement just offered. It is the case of a woman, who, having been long afflicted with a hardness of hearing, was suddenly seized with violent convulsions, without any apparent cause, and soon afterwards complained of an acute pain in the ear. This affection was followed by a recurrence of convulsions, which were still more vehement. A small tent of fine linen, moistened with a mixture of oil and laudanum, was introduced into the meatus auditorius, and, on removing it the next day, several small round worms were observed upon it, and, from that period, all the symptoms disappeared. To this case, we shall add another from Morgagni: — A young woman consulted Valsalva, and told him, that when she was a girl, a worm had been discharged from her left ear; that another one, about six months ago, had also been discharged, very much like a small silkworm in shape. This event took place after very acute pain in the same ear, the forehead and temples. She added, that since this, she had been tormented with the same pains, at different intervals, and so severely, that she often swooned away for two hours together. On recovering from this state, a small worm was discharged, of the same shape as, but much smaller than, the preceding one, and she was now afflicted with deafness and insensibility on the same side. After hearing this relation, Valsalva no longer entertained any doubt of the membrane of the tympanum being ulcerated. He proposed the employment of an injection, in order to destroy such worms as yet remained. For this purpose, distilled water of St. John's wort, in which mercury had been agitated, was used. In order to prevent a recurrence of the inconvenience, Morgagni recommends the affected ear to be closed up when the patient goes to sleep, in autumn and summer. If this be not done, flies, attracted by the suppuration, enter the meatus auditorius, and, while the patient is unconscious, deposit their eggs in the ear. Acrel, in speaking of worms, generated in the meatus auditorius, observes, that there is no better remedy for them, than the decoction of ledum palustre, injected into the ear, several times a day. However, as this plant cannot always be procured, an infusion of tobacco in oil of almonds may be used, a few drops of which are to be introduced into the ear, and retained there by means of a little bit of cotton. This application, which is not injurious to the lining of the passage, is fatal to insects, and especially to worms. When caterpillars, ants, earwigs, and other insects, have insinuated themselves into the meatus auditorius, they may be removed with a piece of lint, smeared with honey; and when they cannot be extracted by this simple means, they may sometimes be taken out with a small pair of forceps. In general, however, the most safe and expeditious practice for the removal of small insects, peas, beads, and other extraneous bodies, from the meatus auditorius, is to throw tepid water into the passage with a proper syringe, by which means they are forced out with the fluid. When the bead, or globular substance is small, (according to Mr. Buchanan) the best mode of extraction will be by means of the syringe, and injection of tepid water. For this purpose, the point of the syringe ought to be pressed gently against the edge of the meatus, so that it may occupy as little of the diameter of the tube as possible, and when the injection arrives at the membrana tympani, the regurgitation will force the bead, or other substance outwards. If this be rather large, it may perhaps remain at the entrance of the meatus, whence it ought to be extracted by means of a pair of forceps. (See *Buchanan's Illustrations of Acoustic Surgery*, p. 40.)

In May, 1829, I was called to a child about two years and a half old, into one of whose ears a pebble, and into the other a French bean, had been pushed by another child, and remained there for ten months, causing complete deafness and extreme suffering. By throwing tepid water forcibly into the ear, I soon dislodged these foreign bodies, which lay close against the tympanum, entirely hidden by the swollen state of the lining of the ear, indurated wax, and dried discharge. With a bent probe their extraction was then readily effected. Several surgeons, previously consulted, had failed in their endeavours to remove the substances by other methods.

The presence of foreign bodies in the ear often occasions the most extraordinary symptoms, as we may see in the fourth observation of Fabricius Hildanus, Cent. 13. After four surgeons, who had been successively consulted, had in vain exerted all their industry to extract a bit of glass from the left ear of a young girl, the patient found herself abandoned to the most excruciating pain, which soon extended to all the side of the head, and which, after a considerable time, was followed by a paralysis of the left side, a dry cough, suppression of the menses, epileptic convulsions, and, at length, an atrophy of the left arm. Hildanus cured her, by extracting the piece of glass, which had remained eight years in her ear, and had been the cause of all this disorder. Although the extraction must have been very difficult, it does not appear that Hildanus found it necessary to practice an incision behind the ear, as some authors have advised, and amongst them Duverney, who has quoted the foregoing case. We must agree with Leschevin, that such an incision does not seem likely to facilitate the object very materially; for, it must be on the outside of the extraneous substance, which is in the bony part of the canal. The incision enables us, in some measure, to avoid the obliquity of the passage, as Duverney has observed; but it is not such obliquity of the cartilaginous portion of the canal, that can be a great impediment; for, as it is flexible, it may easily be made straight, by drawing the external ear upward. Hence, Fabricius ab Aquapendente rejected this operation, first proposed by Paulus Ægineta; and it is justly disapproved of by Leschevin. (*Prix de l'Acad. de Chir.* t. ix. p. 147. édit. 12mo.)

Sabatier relates a case, in which a paper ball, which had been pushed into the meatus auditorius, made its way by ulceration into the cavity of the tympanum, where an abscess formed, which communicated with the interior of the cranium. (*Dict. des Sciences Méd.* t. vii. p. 8.)

6. *Meatus Auditorius obstructed with thickened, or hardened Cerumen.*

The cerumen, secreted in the meatus auditorius by the sebaceous glands, frequently accumulates there in large quantities, and becoming harder and harder, at length acquires so great a degree of solidity as entirely to deprive the patient of the power of hearing. Galen has remarked, *è numero eorum quæ meatum obstruunt, sordes esse quæ in auribus colligi solent.* This species of deafness is one of those kinds, which are the most frequent and, at the same time, the most easy of cure. Formerly injections, either with simple olive oil, or oil of almonds, were recommended. The injection was retained by a piece of cotton, and when there was reason to believe that the matter was sufficiently softened, an attempt was made to extract it by means of a small scoop-like instrument. Various experiments were made by Haygarth, at Chester, in 1769, from which it appears that warm water is preferable to oil. The water dissolves the mucous matter, which connects together the truly ceruminous particles, and which is the cause of their tenacity; other applications only succeeding by reason of the water which they contain.

The lodgment of hard pellets of wax, if neglected, may ultimately produce ulceration of the tympanum, and other serious mischief. Thus, in one case, Ribes and Chaussier found the handle of the malleus separated from its head, partly destroyed, and covered with the hardened cerumen that had made its way into the tympanum. (See *Dict. des Sciences Méd.* t. xxxviii. p. 30.)

" The symptoms (says Mr. Saunders) which are attached to the inspissation of the cerumen are pretty well known. The patient, besides his inability to hear, complains of noises, particularly a clash or confused sound in mastication, and of heavy sounds, like the ponderous strokes of a hammer.

" The practitioner is led by the relation of such symptoms to suspect the existence of wax; but he may reduce it to a certainty by examination.

" Any means capable of removing the inspissated wax may be adopted; but syringing the meatus with warm water is the most speedy and effectual, and the only means necessary. As the organ is sound, the patient is instantaneously restored." (*Anatomy of the human Ear, with a Treatise on its Diseases, by J. C. Saunders,* 1806. p. 27, 28.)

In order to throw an injection into the ear with effect, a syringe, capable of holding from four to six ounces, should be employed; and the fluid injected with a good deal of force, care being taken to let it enter in the natural direction, and not against one of the sides of the passage. The surgeon must also avoid pressing the pipe too deeply into the ear, so as to hurt the tympanum. As the fluid regurgitates with considerable rapidity, a small basin is to be held close up to the ear at the time of using the syringe, so as to catch the water, and hinder it from wetting the patient's clothes; for the surer prevention of which a napkin is also to be laid over the shoulder. In general it is necessary to throw the water into the ear six or seven times, or more, ere the pellets of wax are loosened, and entirely brought out; and sometimes, the injections will not completely succeed the first day on which they are employed. The evening before the syringe is to be used, a little sweet oil may be dropped into the ear.

7. *Imperfect Secretion of Wax.*

When the wax is deficient in quantity, Mr. Buchanan recommends warmth and stimulant applications. He advises two drops of the following mixture to be introduced into the meatus auditorius, every night at bedtime: — ℞. Acid. Pyrolign. Spir. Ætheris Sulphur. Ol. Terebinth. āā M. One tablespoonful of the following medicine is also to be taken at the same time: — ℞. Tinct. Colchici ʒiij. Aq. distillat ℥ vj. M. If costiveness prevail, the pilulæ rhei. comp. are to be given. (See *Buchanan's Acoustic Surgery,* p. 60.)

When the quality of the secretion requires improvement, the meatus is to be frequently washed out, and a little of the infusion of quassia with rhubarb and magnesia given once or twice a day. The warm bath is to be occasionally used at bedtime, and the following powder exhibited: — ℞. Hydrarg. Submur. gr. ij. Pulv. Ipecac. comp. ℈j. ft. Pulv. Hora decubitus sumend. In cases where the ear is preternaturally dry, and the cuticle of the meatus peels off, the ensuing injection is to be used every second or third day. ℞. Acid. Pyrolign ʒij. Aquæ distillatæ ℥ vi. ft. lotio; or the vapour of a mixture of equal parts of distilled water and pyroligneous acid introduced three times a week into the meatus with the aid of a glass retort. A little cotton should afterwards be put into the ear. (See *Buchanan's Acoustic Surgery,* p. 62.)

8. *Discharges from the Meatus Auditorius.*

Purulent discharges from the ear either come from the meatus auditorius externus itself, or they originate from suppuration in the tympanum, in consequence of blows on the head, abscesses after malignant fevers, the small-pox, or the venereal disease. In such cases, the little bones of the ear are sometimes detached, and escape externally, and complete deafness is most frequently the consequence. However, in a few instances, total deafness does not always follow even this kind of mischief, as I myself have witnessed on one or two occasions. There is greater hope when the disorder is confined to the meatus; as judicious treatment may now avert the most serious consequences.

In Acrel's surgical cases, there is a case relative to the circumstance of which we are speaking. Suppuration took place in the meatus auditorius externus, in consequence of acute rheumatism, which was followed by vertigo, restlessness, and a violent headach. The matter discharged was yellowish, of an aqueous consistence, and acid smell. The meatus auditorius was filled with a spongy flesh. On introducing a probe, our author felt a piece of rough bone, which he immediately took hold of with a pair of forceps, and extracted. From the time when this was accomplished, the discharge diminished; and, with the aid of proper treatment, the patient became perfectly well.

The meatus auditorius, like all other parts of the body, is subject to inflammation. This is frequently produced by exposure to cold. It is hardly necessary to say, that generally topical bleeding and antiphlogistic means are indicated. The meatus auditorius should also be protected from the cold air, particularly in the winter season, by means of a piece of cotton.

Mr. Saunders observes, "When the means employed to reduce the inflammation have not succeeded, and matter has formed, it is generally evacuated, as far as I have observed, between the auricle and mastoid process, or into the meatus. If it has been evacuated into the meatus, the opening is most commonly small, and the spongy granulations, squeezed through a small aperture, assume the appearance of a polypus. Sometimes the small aperture, by which the matter is evacuated, is in this manner even closed, and the patient suffers the inconvenience of frequent returns of pain from the retention of the discharge. When the parts have fallen into this state, it will be expedient to hasten the cure by making an incision into the sinus, between the auricle and mastoid process.

"It occasionally happens, that the bone itself dies in consequence of the sinus being neglected, or the original extent of the suppuration. The exfoliating parts are the meatus externus of the os temporis, or the external lamina of the mastoid process." (P. 24, 25.)

In some examples of purulent discharge from the ear, and particularly in scrofulous patients, Mr. Buchanan employs alterative medicines, as calomel, the tincture of iodine, and the compound rhubarb pills of the *Edinb. Pharmacopœia.* He also sometimes has recourse to the pyroligneous injection. (See *Illustrations of Acoustic Surgery*, p. 93, &c.) Some additional cases in favour of the efficacy of iodine, in certain forms of deafness, may be found in Dr. Manson's work. (See *Medical Researches on the Effects of Iodine*, 8vo. London, 1825.

9. *Excrescences in the Meatus Auditorius.*

Though the membrane, lining the meatus auditorius, is very delicate, it is not the less liable to become thickened, and to form polypous excrescences. As such tumours are ordinarily firmer in their texture than polypi of the nose, they are sometimes not so easily extracted with forceps. When they are situated near the external orifice, and admit of being taken hold of with a small pair of forceps, or a hook, and drawn outwards, they may easily be cut away. Sometimes the excrescences, instead of being adherent by a narrow neck, have a broad base, which occupies a considerable extent of the passage. In such cases, the use of escharotics has been proposed; but, they cannot be used without risk of injuring the tympanum. Mr. Buchanan prefers the practice of removing polypi of the meatus with forceps, and afterwards touching the part from which they grew with the ung. hydrarg. nitrat. or tinct. ferri muriati. (*Acoustic Surg.* p. 74.) He also recommends washing out the passage every day with the injection, ℞. Acid. Pyrolign. ʒij. Aq. distillatæ ℥vj. ft. lotio. I lately attended a lady, who had a round smooth tumour growing from the membrana tympani, to which it was attached by means of a long pedicle. It nearly filled the meatus, and was attended with a discharge. With the assistance of Mr. Morton, of University College, I cut through its pedicle, removed it, and then applied the nitrate of silver. But, in a few weeks, it grew again, and it was once more removed with the same result. I next intended to twist it off; but, it was attacked with inflammation, and sloughed away. I do not at present know whether it is growing again.

10. *Herpes of the Meatus Auditorius.*

An herpetic ulcerous eruption sometimes affects the meatus auditorius and auricle, producing considerable thickening of the skin, and so great an obstruction of the passage, that a good deal of deafness is the consequence. Mr. Saunders remarks, that, in this case, "the ichor, which exudes from the pores of the ulcerated surface, inspissates in the meatus, and not only obstructs the entrance of sound, but is accompanied with a great degree of fetor. This disease is not infrequent. I have never seen it resist the effect of alterative medicines," the use of injections containing the oxymuriate of quicksilver, and the application of the unguentum hydrargyri nitrati. Mr. Saunders exhibited calomel as the alterative, and in one instance, employed a solution of the argentum nitratum as an injection. (P. 25, 26.) When the disease is obstinate, a seton should be made on the nape of the neck, or a blister be applied behind the ear. The tincture of iodine should also be tried.

11. *Affections of the Tympanum.*

The ear is sometimes affected with a puriform ichorous discharge, attended with a loss of hearing, proportionate to the degree of disorganisation which the tympanum has sustained. Frequently, on blowing the nose, air is expelled at the meatus auditorius externus; and, when this is the case, it is evident that the discharge is connected with an injury, or destruction of the membrana tympani. However, when the Eustachian tube is obstructed with mucus, or matter, or when it is rendered impervious, and permanently closed by inflammation, the membrana tympani may not be perfect, and yet, it is clear, no air can in this state be forced out of the external ear in the above manner. An examination with a blunt probe, or with the eye, while the rays of the sun fall into the passage, should therefore not be omitted. If the membrane have any aperture in it, the probe will pass into the cavity of the tympanum, and the surgeon feel that his instrument is in contact with the ossicula.

In this manner, the affection may be discriminated from an herpetic ulceration of the meatus auditorius externus. The causes are various: In scarlatina maligna, the membrana tympani occasionally inflames and sloughs; all the ossicula are discharged, and, if the patient live, he often continues quite deaf. An earach, in other words, acute inflammation of the tympanum is the most common occasion of suppuration in this cavity, in which, and the cells of the mastoid process, a good deal of pus collects. At length the membrana tympani ulcerates, and a large quantity of matter is discharged; but, as the secretion of pus still goes on, the discharge continues to ooze out of the external ear.

Instead of stimulating applications, inflammation of the tympanum demands the rigorous employment of antiphlogistic means. Unfortunately, it is a too common practice, in this case, to have recourse to acrid spirituous remedies. Above all things, the repeated application of leeches to the skin behind the external ear, and over the mastoid process, should never be neglected. As soon as the inflammation ceases, the degree of deafness, occasioned by it, will also disappear. This, however, does not always happen.

When an abscess is situated in the cavity of the tympanum, Mr. Saunders thinks that the membrana tympani should not be allowed to burst by ulceration, but be opened by a small puncture. (P. 31.) However, unless there were the strongest ground for believing, that the Eustachian tube were impervious, this advice, I think, ought not to be followed, more especially as the symptoms are generally too vague to afford any degree of certainty in the diagnosis.

Sometimes the disease, of which we are treating, is more insidious in its attack: slight paroxysms of pain occur, and are relieved by slight discharges. The case goes on in this way, until, at last, a continual discharge of matter from the ear takes place. The disorder in its tendency is destructive to the faculty of hearing, and it rarely stops until it has so much disorganised the tympanum and its contents, as to occasion total deafness. Hence, Mr. Saunders insists upon the propriety of making attempts to arrest its progress, — attempts which are free from danger; and he censures the foolish fear of interfering with the complaint, founded on the apprehension, that bad constitutional effects may originate from stopping the discharge.

If the case be neglected, the tympanum is very likely to become carious; before which change, the disease was considered by Mr. Saunders, to be mostly curable.

Mr. Saunders divides the complaint into three stages: — 1. A simple puriform discharge. 2. A puriform discharge complicated with fungi and polypi. 3. A puriform discharge with caries of the tympanum. As the disease is local, direct applications to the parts affected are chiefly entitled to confidence. Blisters and setons may also be advantageously employed. Mr. Saunders's practice consisted in administering laxative medicines and fomenting the ear, while inflammatory symptoms lasted, and afterwards injecting a solution of the sulphate of zinc, or acetate of lead.

In the second stage, when there were fungi, he removed or destroyed them with forceps, afterwards touched their roots with the argentum nitratum, or injected a solution of alum, sulphate of zinc, or argentum nitratum.

Writers describe a relaxed state of the membrana tympani, as a cause of deafness. If, says a late author, after a discharge from the meatus auditorius externus, or cavity of the tympanum, or a dropsy of the latter cavity, the hearing remains hard, there is reason to suspect, that the infirmity may depend upon relaxation of the membrane of the tympanum, or paralysis of the internal muscle of the malleus. This suspicion will be strengthened, if the deafness should increase in damp, and lessen in dry, weather; and particularly, if it be found, that the hearing is benefited by introducing into the ear dry warm tonic applications, such as the smoke of burning juniper-berries, or other astringent vegetable substances. The decoction of bark, used as an injection, is also said to have done good.

The relaxation of the tympanum, alleged to proceed from a rupture of the muscle of the malleus, is deemed incurable; but it is not so with the case, which depends upon paralysis of this muscle. Here tonic injections into the tympanum, through the Eustachian tube, are recommended. (*Dict. des Sciences Méd.* t. xxxviii. p. 50.) Electricity, stimulating liniments, gargles, a blister, or the external use of strychnia, might also be tried.

Imperfect hearing is supposed sometimes to arise from preternatural tension of the membrane of the tympanum, indicated by the patient hearing better in wet than dry weather, and by his hearing what is spoken in a low tone, near his ear, better than any thing said in a loud manner. The opinions, delivered by writers on the causes of this affection, are only uncertain conjectures. The local treatment recommended consists in injecting into the meatus auditorius emollient decoctions, or warm milk, or introducing into the passage a dossil of soft cotton, dipped in oil of sweet almonds. Nothing certain is known respecting the proper constitutional treatment, as must be clear from our ignorance of the causes of this form of disease of the ear.

Hardness of hearing appears sometimes to be caused by a chronic thickening of the membrane of the tympanum; and it is alleged, that there are cases of this description, which proceed from syphilis, and require mercury. An issue in the arm nearest the affected ear, the tincture of iodine, and emollient and slightly stimulant injections, are likewise commended. When the tympanum was so considerably thickened, that there was no chance of restoring it to a healthy state, Portal questioned whether it might not be advisable to make a small opening in it? (*Précis de Chir. Pratique*, t. ii. p. 430.) This operation, which is said to have been first suggested by Cheselden, will be considered in the ensuing section.

Morgagni found the cavity of the tympanum intersected by numerous membranes, which impeded the movements of the ossicula. (*Epist.* an. vi. § 4.

Meckel does not mention any example of a deficiency of all the ossicula. (*Handb. des Pathol. Anat.* b. i. p. 402.) Mersanni, however, found the incus wanting. (*Bonet Sepulch.* t. i. sect. 19. obs. 4. § 1.) Caldani, the malleus and incus. (*Epist. ad Haller*, t. vi. p. 142.) The latter case was unattended with any bad effect on the hearing; the first with deafness. In a deaf child, three years of age, Bailly found the ossicula of only $\frac{1}{3}$ their proper size. (*Bonet. Sepulch.* t. i. sect. 19. obs. 4. § 3.) In an example, where the fenestra rotunda was obstructed, Cotunni found the ossicula twice as large as natural. (*De Labyrinthi Auris contentis*, § 72., and *Meckel's Handb. des Pathol. Anat.* b. i. p. 402.) A case, in which all the ossicula were wanting, is on record. (See *Dict. des Sciences Méd.* t. xxxviii. p. 114.)

12. *Obstruction of the Eustachian Tube.*

This is often a cause of a considerable degree of deafness, because it is necessary for perfect hearing, that air should be conveyed from the mouth through this passage into the cavity of the tympanum, which now can no longer happen.

A degree of deafness generally attends a severe cold, which is accounted for by the Eustachian tube being obstructed with thickened mucus. Mr. Saunders tells us, that the obstruction most frequently arises from syphilitic ulcers in the throat, or sloughing in the cynanche maligna. The deafness comes on when such sores are healed, that is, when the obstruction is complete. The descent of a nasal polypus into the pharynx, and enlarged tonsils, have also been known to close the tube. (P. 42.)

When the Eustachian tube is obstructed, the patient cannot feel the membrana tympani crackle, as it were, in his ear, on blowing forcibly with his nose and mouth stopped. Previous ulceration, or disease, of the throat will sometimes facilitate the diagnosis.

When the Eustachian tube is obstructed with mucus, it has been proposed to employ injections, which are to be thrown, by means of a syringe and catheter, into the guttural orifice of that canal. This operation will be presently described.

Sir A. Cooper had noticed, that hearing was only impaired, not lost, when suppuration in the tympanum had injured, and even destroyed the membrana tympani, and that the degree of deafness by no means equalled what resulted from an obstruction of the Eustachian tube. Hence, when the tube was permanently obliterated, he conceived, that a small puncture of the membrana tympani might be the means of enabling the patient to hear. This gentleman reports four cases, in which the experiment was made with success.

The operation consists in introducing an instrument, resembling a hydrocele trocar, but curved, into the meatus auditorius externus, and pushing it through the anterior and inferior part of the membrana tympani; a place rendered most eligible, on account of the situation of the chorda tympani and manubrium of the malleus, parts which should be left uninjured. The instrument must not be introduced far, lest it wound the vascular lining of the tympanum, and cause a temporary continuance of the deafness, by an effusion of blood. When the puncture is made, in proper cases, and in a judicious manner, hearing is immediately restored. A small hole in the membrana tympani now conveys the air into the cavity of the tympanum, answering the same purpose as the Eustachian tube.

The surgeon will be able to operate with more ease, if he take care to lessen the curvature of the meatus auditorius by drawing upward the external ear.

There is some chance of a relapse in consequence of the opening closing up. This consideration led Richerand to propose making the aperture with caustic, so as to destroy a part of the membrane. (*Nosogr. Chir.* t. ii. p. 132. éd. 2.) This suggestion is not likely to be adopted on account of the inconveniences of applying caustic within the ear. Mr. Saunders is an advocate for making the opening large. However, perhaps the best method of doing the operation both effectually and safely is that lately described by Mr. Buchanan of Hull, the chief peculiarity of whose mode consists in *drilling* the perforation. The quadrangular point of his perforator cuts the fibres of the membrana tympani across; they retract; the wound assumes an oval shape; and there is less danger of its closure again, than after the common plan of making a single puncture. "A room (says Mr. Buchanan) with a window fronting the south, should be chosen for the place of the operation; and the patient placed on a low seat, so that the rays of the sun may fall into the meatus. The manubrium, or handle of the malleus will then be distinctly seen, pointing downwards and inwards; occupying the superior half of the membrana tympani. The surgeon being seated on a high chair, should lay his left hand on the head of the patient, and, with the right, take hold of the instrument in the same manner as he would a pen when writing: he should then cautiously and steadily enter the point of the perforator into the membrana tympani, about half-way between the centre and its lower edge, and, with the thumb and index finger, give the instrument half a turn one way, and then half a turn the other, and in this manner gently push the point about a line through the membrane." (See *Engraved Representation of the Anatomy of the Ear*, p. 33.) Mr. Saunders, by puncturing the tympanum, instantaneously restored the hearing of one patient, who had been deaf thirty years in consequence of the destruction of a part of his palate by syphilis. (P. 45.) In an instance where a young man had been deaf for eight years, apparently from obstruction of the Eustachian tube by swellings and disease about the throat, Paroisse also restored the hearing directly, by perforating the anterior and inferior part of the tympanum. (*Opuscules de Chir.* p. 309. 8vo. Paris, 1806.) The practice has also been successfully adopted by Michaelis in one case, and Hunold has tried it in a vast number of examples, two-thirds of which succeeded. (*Dict. des Sciences Méd.* t. 38. p. 63.) Sir A. Cooper's cases are in the *Phil. Trans. for* 1802.

Puncturing the membrana tympani has been attended with some degrees of success in France, where it has been tried by Itard, Celliez, and Maunoir, &c. It is not to be dissembled, however, that it is liable to failure. Dubois performed the operation in four instances, without success. (*Richerand, Nosogr. Chir.* t. ii. p. 132.)

In most cases the patients benefited are said to have experienced pain just after the trocar was withdrawn. The organ, not being accustomed to sound, had become so extremely sensible, that it could not bear the gentlest impression of the sonorous vibrations; and the patient's first request, after the perforations had been made, was, that persons near him, might speak softly. This excessive tenderness of the sense gradually subsides.

The two principal objections made to the foregoing practice, are the risk of injuring that part of the tympanum, which is connected with the malleus, and the tendency of the puncture to heal up again. (See *Dict. des Sciences Méd.* t. xxxviii. p. 57.; *Maunoir in Journ. de Méd.* t. xiii.; *Saba-*

tier, Traité d'Anatomie, t. ii. p. 186.) The author of the article Oreille in the latter dictionary, who cannot, however, be deemed at all partial to the operation, delivers the following judgment concerning it: — 1. It is the only operation, which is likely to answer, where the tympanum is cartilaginous or ossified, and the rest of the organ is sound. 2. It will be attended with some success, where the Eustachian tube is closed, and this defect cannot be otherwise removed. 3. It will be useless where the cavity of the tympanum is filled with matter, which is too thick to escape through the puncture. 4. When deafness depends on paralysis of the auditory nerve. 5. When the infirmity arises from inflammation of the ear or nervous irritation. 6. Or from fevers, the Eustachian tube being pervious.

Wathen, Boyer, Itard, Buchanan, and the latest surgeons, who have considered the operation of injecting fluids into the Eustachian tube, agree, that it is more easily performed by passing the tube through one of the nostrils, than the mouth. The patient being seated on rather a low chair, with his head supported upon the breast of an assistant, standing behind him, the surgeon takes a probe, which is bent towards its end to an angle of about 135°, and he introduces it, with the end turned downwards, along the floor of the nostril, and, when it has reached the pharynx, a circumstance denoted by its descent behind the soft palate, a rotatory movement outwards to the extent of a quarter of a circle is given to it, and the handle is inclined downwards and inwards. The instrument's becoming fixed denotes its entrance into the Eustachian tube. (See *Ph. F. Blandin* in *Dict. de Méd. et de Chir. Pratiques,* t. xii. p. 280.) Wathen's instruments are described in *Phil. Trans.* 1794; those of Boyer in *Traité des Mal. Chir.* t. vi. p. 391, ; those of M. Itard, which deserve particular notice, in his *Traité des Mal. de l'Oreille;* and those of another modern advocate for this operation, in *Dict des Sciences Méd.* t. xxxviii. p. 108. The latter author, after stating how his tubes, which are four French inches in length, and shaped somewhat like an italic *S*, are introduced, enumerates the following as the advantages derived from their employment. 1. Fluid applications may be conveyed into the Eustachian tube, the cavity of the tympanum, and the mastoid cells, and deeply seated obstinate ulcerations within these parts cured. 2. The same parts can be cleared from any mucus by which they are obstructed. 3. Blood extravasated within the tympanum, from blows on the head, can be washed out. 4. Chalky substances, which sometimes form in the tympanum, may be brought out in the same manner. 5. Through the tube a stilet can be passed into the Eustachian tube, so as to perforate a congenital septum, or any cicatrix, obstructing the entrance of that passage. 6. When the sensibility of the auditory nerve is dull, the effect of fluids, thrown into the tympanum, can be tried. (See also *T. Buchanan's Engraved Representation of the Anatomy of the Human Ear,* p. 28. fol. Hull, 1823.)

13. *Of perforating the Mastoid Process.*

Of all the cases of deafness for which Arnemann and others have recommended this operation, that attended with an abscess and caries of this process is the only one, in which the practice is now at all sanctioned. An instance is related by Jasser, in which the carious surface of the right mastoid process was exposed by an incision, and an opening detected with a probe. An injection was thrown into the aperture with a syringe, when, to the astonishment of Jasser and his patient, the fluid gushed out of the right nostril. The plan was repeated for a few days, and at the end of three weeks, the part was healed, and the hearing greatly improved. This success induced Jasser to make a perforation in the left mastoid process, the ear on that side being deaf, and to employ the injection, which was also discharged from the left nostril. The hearing, however, was not so completely restored in this as it had been in the right ear; but the wound healed up without any exfoliations. (*Journ. de Méd. Fev.* 1793.) The idea of perforating the mastoid process was suggested long before the time of Jasser. Riolan, in various parts of his works, mentions the propriety of making a small perforation in several cases of deafness, and tinnitus aurium, attended with obstruction of the Eustachian tube. Rolfincius also advised a similar opening to be made in the mastoid process with a trocar, in cases of dropsy of the cavity of the tympanum and of the mastoid cells. Jasser, however, was the first who actually made the experiment, and his example was followed by Hagstroem, whose attempt did not succeed, the completion of the operation having been interrupted by profuse hemorrhage, and no benefit done to the hearing. The injections also appear to have caused, in this instance, alarming symptoms, violent pains in the head, loss of vision, sense of suffocation, and syncope. The fluid entered the mastoid cells, without any of it issuing, either by the nostrils or mouth. (*Op.* cit.)

The operation was successfully tried by Loffler. The injection did not pass into the mouth, yet the hearing was restored, though it was lost again when the wound closed. Hence a new opening was made, and kept from healing by means of a piece of catgut. The patient was afterwards able to hear when his mouth was open.

The perforation of the mastoid process was not approved of by Morgagni; indeed, it must often fail, as both Morgagni and Hagstroem have observed, on account of complete bony partitions preventing all communications between the mastoid cells; and sometimes the mastoid process, instead of being cellular, is perfectly solid, an instance of which is recorded by A. Murray. In children, the mastoid cells are but imperfectly developed, and the operation may bring on caries, necrosis, erysipelas, &c. (See *Blandin in Dict. des Méd. et de Chir. Pratiques,* t. xii. p. 281.)

14. *Diseases of the Labyrinth.*

These are much more diversified than might, at first, be supposed, and, if we admit the two doubtful cases, said to depend upon the state of the lymph of Cotunni, there are not less than seven different species of disease affecting the labyrinth: —1. Disease of the fenestra ovalis, and fenestra rotunda, as ulceration, thickening, &c. 2. Malformation of these apertures. 3. Malformation of the labyrinth. 4. Inflammation of the nervous membrane, which lines its cavities. 5. Alteration of the liquor of Cotunni. 6. Deficiency of the same fluid. 7. Affections of the nerve of hearing.

No doubt deafness (and that kind of it which so frequently foils the most skilful men) often arises from an insensible state of the portio mollis of the auditory nerve, or of the surfaces on which its filaments are spread. This affection is analogous to amaurosis, or gutta serena, in which, though every part of the eye may seem to possess its natural structure, sight is lost, because the rays of light only strike against a paralytic, or insensible retina. Mr. Saunders dissected the ears of two deaf patients with the greatest care, but could not discover the least deviation from the natural structure. In the commencement of deafness from a paralytic affection of the auditory nerve, Sir A. Cooper remarked, that the secretion of cerumen was diminished, and, when the deafness became worse, was totally suppressed. And another particular symptom of paralysis of the auditory nerve, pointed out by the same author, is the patient's inability to hear the sound of a watch placed between the incisor teeth.

With respect to the causes of a paralytic affection of the auditory nerve, they are mostly buried in great obscurity, and some of them probably depend upon congenital imperfection of the nerve, or brain itself. It seems, however, that a part of the causes to which we allude, act mechanically, as an extravasation of blood, a steatoma, or an exostosis; while others operate on the ear by sympathy, as is the case when deafness is produced by the presence of worms in the bowels.

Mr. Saunders remarks, that all the diseases of the internal ear may be denominated nervous deafness; the term, in this sense, embracing every disease, the seat of which is in the nerve, or parts containing the nerve. Nervous deafness is attended with various complaints in different cases, noises in the head of sundry kinds, the murmuring of water, the hissing of a boiling kettle, rustling of leaves, blowing of wind, &c. Other patients speak of a beating noise corresponding with the pulse, and increased by bodily exertion, in the same degree as the action of the heart. (*Saunders*, p. 47.)

According to this author, there is a syphilitic species of nervous deafness, attended with a sensation of some of the above peculiar noises; and one case is related, in which the hearing was completely restored, in five weeks, by a mercurial course.

Mr. Saunders relieved several cases of nervous deafness by confining patients to low diet, giving them calomel freely, repeated doses of sulphate of soda, or magnesia, sometimes twice, sometimes thrice, a week, or according to circumstances, and applying blisters behind the ears at intervals of a week. The plan requires perseverance.

Electricity has been highly recommended for the cure of nervous deafness, though the prospect of benefit from it must entirely depend upon the nature of the cause of the infirmity. It is allowed to be sometimes useful in cases of incomplete paralysis of the auditory nerve; but it cannot be of any service where the Eustachian tube, the cavity of the tympanum, or the mastoid cells, are obstructed. It is set down as hurtful, when the patients are very irritable, and subject to vertigo, bleeding from the nose, great determination of blood to the head, &c. (*Dict. des Sciences Méd.* t. xxxviii. p. 124.) The evidence in favour of the efficacy of galvanism, is still more scanty and questionable.

Whether, in certain cases of deafness from torpor of the auditory nerve, the introduction of tonic injections into the cavity of the tympanum, through the Eustachian tube, will answer in the manner stated by a late writer, future experience must determine. (*Dict. des Sciences Méd.* t. xxxviii. p. 120, 121.) The effect of the tincture of iodine, blisters, mercury, and the external use of strychnia, are means often deserving a fair trial.

This article, I think, may be usefully concluded with a few general, but sensible, observations on the various kinds of deafness, made by a modern writer. According to Professor Rosenthal, all the disorders of the sense of hearing may be comprised under three principal forms.

1. Deafness (*Surditas, Cophosis*), in which the faculty of hearing articulated sounds is completely annihilated.

2. Hardness of hearing (*Dysœcia*), in which this faculty is so diminished, that articulated sounds cannot be heard, without the assistance of a particular apparatus.

3. Alteration, or diminution of hearing (*Paracusis*), in which the faculty of hearing articulated sounds, in the natural way, is imperfect for want of precision.

1. *Deafness*, Rosenthal distinguishes into two degrees; the first of which is marked by an absolute impossibility of hearing at all; the second, by a power of still distinguishing certain sounds, as whistling, the vowels, &c. The first is usually congenital, and a cause of dumbness.

The discrimination of these two degrees, Rosenthal considers of great importance in practice, and especially in institutions for the deaf and dumb; because the exceedingly fine sense of touch, with which dumb persons are sometimes gifted, is apt to be mistaken for the faculty of hearing. This fact is illustrated by some interesting experiments made by Pfingsten on deaf and dumb persons. (*Vieljahrige Erfahrung über die Gehoerfehler der Taubstummen*, Kiel, 1802. p. 32.) A deaf and dumb girl, who was at needlework in a room near the house door, regularly gave notice whenever it was opened, or shut. As the door was furnished with a little bell, which rang loud enough whenever the door moved to be plainly heard in the neighbouring room, and with the exception of this noise, no other impulse nor shock could be distinguished, Pfingsten was surprised at the circumstance. Desirous of ascertaining how the girl really knew about the movements of the door, he caused the bell to be rung with great force without the door being opened: the child was perfectly unconscious of the noise. The bell was afterwards kept still, while a person opened and shut the door so softly, that Pfingsten himself could not hear it; yet, the child instantly gave warning, that somebody had entered. The inference was, that the chair, on which she sat, communicated to her legs and back a certain impulse, which made her conscious of the motion of the door.

The dissection of the ears of deaf and dumb persons has evinced some facts, explanatory of the cause of the loss of hearing. Amongst other things, it appears, that complete deafness, whether congenital or acquired, more frequently depends upon morbid alterations of the soft parts, than upon any irregularity in the formation of the bones. Thus, in the body of a person, who had been deaf and dumb while living, Hoffmann found the auditory nerve diminished in size, while every other part of the organ was perfectly natural. Arnemann found the nerve harder than common. Dr. Haighton met with an instance, in which the vestibulum was filled with a caseous substance. (*A Case of original Deafness, in Mem. of the Med. Society*, vol. iii. p. 1—15.) Duverney and Sandifort found the auditory nerve strongly compressed by a steatoma. In one case, Itard found every part of the ear apparently so natural, that the deafness could not be ascribed to paralysis of the nerve. In another, the infirmity depended upon obstruction of the passages. In a third, the cavity of the tympanum, and the vestibulum, contained small portions of calcareous matter. He has also seen the tympanum filled with a thick yellow lymph, or a thin fluid enclosed in membranous cells. In the dissection of the body of a deaf and dumb person, Rosenthal noticed amongst other remarkable circumstances, a greater hardness of the auditory, than of the facial nerve, and preternatural firmness of the medulla oblongata; thickening of the membrane of the tympanum; the bony roof of the cavity of the tympanum not thicker than paper; and just over the junction of the malleus with the incus, the bony substance was so absorbed, that an appearance like that of membrane alone remained. The mastoid cells, cavity of the tympanum, and the Eustachian tubes, contained a limpid yellow fluid. In the tympanum, the periosteum was thickened, forming small cells, around the ossicula, which were of their natural structure. Nothing particular was remarked in the labyrinth.

In a small proportion of instances, the above degree of deafness has been traced to anomaly in the structure of the solid parts. Thus, Mundini found the cochlea composed of only one circle and a half. (*Opusc. Acad. Bonon.* 1791. t. vii. p. 422.) Valsalva found the stapes adherent to the fenestra ovalis (*De Aure Humanâ*, cap. 11.); and Reimarus relates a case in which the ossicula were entirely wanting. (*Kunstribe der Thiere*, p. 57.)

Mr. Edward Cock has examined the temporal bones of five children, who died of strumous diseases of the thoracic and abdominal viscera, in the Asylum for the Deaf and Dumb. In three instances, one or both ears were the seat of scrofulous ulceration, affecting the tympanum and meatus externus, with partial destruction of the membrana tympani. In one case, the cavity of the tympanum, together with the mastoid cells, was completely filled with the thick cheesy deposit of scrofula, whilst a similar affection pervaded the whole cancellated structure of the petrous bone. The connexions of the ossicula were destroyed, but the bones themselves remained entire. In all the cases, examined by Mr. Cock, the petrous portions of the temporal bones exhibited more than the usual varieties of size and shape. In some, the bone was so deficient in particular spots, as barely to cover the internal cavities, whilst, in others, there was a preternatural osseous development. In one instance, the petrous bone of a child, twelve years old, exceeded in size, hardness, and compactness of structure, that of an adult. One malformation, discovered in two cases, consisted in a partial deficiency of two of the semicircular canals. Their extremities opening into the vestibule, were perfect, but the central portions were impervious, or rather did not exist at all. In one case the scala tympani was terminated at its larger extremity by a bony septum, which separated it from the tympanum, and occupied the situation of the membrane of the fenestra rotunda. With the exception of these malformations, and the scrofulous affections of the tympanum, already mentioned, which were probably of recent occurrence, no deviation from the healthy state could be discovered in either of the five subjects examined. The Eustachian tubes were pervious; the bones, muscles, and membranes entire and natural; the labyrinths were filled with their transparent fluid; and the auditory nerve presented no peculiarity. The chorda tympani existed in each of the cases; but the integrity of all its little filaments, passing into the tympanum, and requiring a microscope for their dissection, could not be vouched for. (*E. Cock* in *Med. Chir. Trans.* vol. xix. p. 152.) In a case, dissected by Mr. Dalrymple, the aqueduct of the vestibule was large enough to admit a small probe; and, in a later examination of the ear of a child, who died in the Asylum for the Deaf and Dumb, Mr. Cock could find no vestige of the fenestra rotunda on either side, the usual situation of the membrane being occupied by solid bone. The temporal bones were exceedingly large, though soft and spongy. The cavities were extraordinarily capacious, and the Eustachian tubes three or four times larger, than common. On one side, the aqueduct of the vestibule readily allowed the passage of a large bristle; but, on the other side, the canal could not be traced through the bone, although its two extremities were more than usually expanded. In one tympanum, suppuration had taken place. (*E. Cock, ib.*)

In the first degree of deafness above described, which, when congenital, must excite suspicion of serious malformation of the organ, and abolition of the nervous influence, and when acquired, indicates a complete injury of the functions of the nerve, the prognosis, as Rosenthal observes, must be unfavourable. Nor can it be otherwise in the second *congenital* degree of the disease, though only a partial imperfection of the organ and nerve can here be supposed. On the other hand, when the latter degree is *acquired*, there is more prospect of relief, because merely a partial alteration in the soft parts is to be suspected.

2. *Hardness of hearing.* Rosenthal also distinguishes several degrees of, what is termed, hardness of hearing. In the first, the patient cannot hear a distant noise, and especially high tones; but he can perceive, though, it is true, not in a very distinct manner, articulated sounds, when the voice is a good deal raised. In the second degree, he hears and distinguishes both high and low tones very well, and also words, but only when the voice is somewhat raised.

These two cases are better understood, inasmuch as it is tolerably well ascertained, that the immediate cause of the infirmity is some alteration in that part of the organ, which serves as a conductor for the vibrations of sound, or else an increased sensibility of the nerve, all the internal ear being in other respects right.

Amongst alterations of the conducting parts of the organ, Rosenthal comprehends:

1. A total obliteration of the meatus auditorius externus, its imperforation, or complete absence. These cases may almost always be detected by a superficial examination, the patient only hearing

when some solid bodies are placed between his teeth, while his dull perception of sounds does not appear to be much lessened when the ear is covered.

2. Diseases of the cavity of the tympanum, as inflammation of its membranous lining, caries of its parietes, or collections of blood, pus, or other fluid, in its cavity. Rosenthal thinks there can be no doubt, that inflammation and suppuration in the tympanum are much more frequent, than is generally supposed, the former affection being often mistaken for a slight attack of rheumatism. In dissecting aged subjects, he has frequently found the membrane of the tympanum thickened and opaque, and he could only impute this appearance to previous inflammation.

After detailing a case illustrative of the symptoms of inflammation within the tympanum, and a few observations on caries and collections of fluid in that cavity, Rosenthal notices the *hardness of hearing, connected with nervous irritability*, in the treatment of which case, he insists upon the advantage that would result from a knowledge of the particular species of morbid excitement prevailing in the patient. But, as nothing very certain can be made out on this point, and only conjectures can arise from dissections of bodies, that the affection consists either in a determination of blood to the part, or in a partial paralysis of the auditory nerve, the exact nature and form of which are quite incomprehensible, it is absolutely necessary to attend solely to the diagnosis of the nervous affection in general. This diagnosis will be facilitated, 1st, If the patient has been previously very sensible to the impression of certain tones, or sound in general; 2dly, If the power of hearing has been lost all on a sudden, without any mark of inflammation; 3dly, If the affection coincides with other nervous disorders.

3. *Alteration or Diminution of Hearing.*

Between the most perfect hearing, congenital or acquired, and this point of diminution of the faculty of hearing, Rosenthal observes, there are a great many degrees, the cause of which is the more difficult to comprehend, as the circumstances of structure, which enable every part to perform its functions with freedom and perfection, are not yet made out. If, says he, it were in our power to determine what is truly the regular structure of each part, we should then be furnished with a means of judging correctly of the anomalies of function, the changes in which would be indicated quite as clearly, as in the eye, by shades of organisation, absolutely in the same way as we judge of the modifications, which the image of objects must undergo at the bottom of the ocular mirror, by the greater or less convexity of the cornea, or lens, or the consistence of the other humours.

In the present state of physiological and pathological knowledge of the ear, therefore, Rosenthal conceives, that little can be attempted with respect to a scientific classification of these cases of altered, or diminished hearing. As the cavity of the tympanum and its contents are the parts, which have principal influence over the intensity of sound, and a great share in the propagation of articulated sounds, their faulty condition must here be chiefly the subject for consideration. And, amongst their numerous defects, traced by dissection, and already specified in the foregoing columns, Rosenthal particularly calls the attention of the reader,

1. To alterations of the membrane of the tympanum, whether proceeding from congenital malformation, or situation, or from thickening, ossification, perforation, or laceration of the same part.

2. The lodgment of fluid in the cavity of the tympanum, more frequently produced, than is commonly supposed, by obstruction of the Eustachian tube. In most new-born infants, Rosenthal has also found the cavity of the tympanum filled with a thick, almost gelatinous fluid, which for some days is not absorbed, and is probably the cause of the indifference, evinced by new-born children, to sounds, which are even so intense as to be offensive to the ears of an adult.

3. Alterations of the membrane of the fenestra rotunda, such as its imperfect formation, or erroneous situation, its thickened state, &c.

But, it is remarked by Rosenthal, that as the difference in the intensity of sound may occasion a modification in the sensations of the ear, the merely conducting parts of the auditory apparatus must not be forgotten, as the external ear and the meatus auditorius externus, which regulate the quantity of sonorous waves striking the auditory nerve. However the malformations of the meatus and the state of the ceruminous secretion within it, are observed by Kritter and Lentin (*Ueber das schwere Gehöre*, l. xix. Leipz. 1794.) to have more effect on the hearing, than defects of the auricle itself, the whole of which, as we have stated, may be lost without any material deafness being produced. Lastly, Rosenthal calls our attention to the nervous action, or influence, which, whether too much raised, or depressed, may equally render the hearing dull; and some useful information may for the most part be derived from attending to the patient's general sensibility.

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ECCHYMOSIS (from ἐκχύω, to pour out). A swelling, attended with a livid or blue colour of the skin, and produced by blood extravasated in the celular tissue.

The causes of ecchymosis are falls, blows, sprains, &c. which occasion a rupture of the small vessels on the surface of the body, and a consequent effusion of blood, even without any external breach of continuity. Ecchymosis is one of the symptoms of a contusion. (See Contusion.) A considerable ecchymosis may originate from a very slight bruise, when the ruptured vessels are capable of pouring out a large quantity of blood, and particularly when the parts contain an abundance of loose, cellular substance. In general, ecchymosis does not make its appearance immediately after the blow, or sprain, and sometimes not till several hours after the application of the violence; at least, it is not till this time that the black, blue, and livid colour of the skin is most conspicuous. A black eye, which is only an ecchymosis, is always more disfigured six or eight hours after the receipt of the blow, than at an earlier period.

A common ecchymosis will generally yield to discutient lotions, and purgatives. The best topical applications are vinegar, the lotio muriatis ammoniæ; spirit. vin. camph. and the liquor ammon. acet.

The object is to prevent inflammation, and to promote the absorption of the extravasated fluid.

I have seen such success attend the practice of dispersing collections of extravasated blood, by means of absorption, that I consider the plan of evacuating it by an incision seldom necessary. When an opening is made, and air is admitted, the portion of blood, which cannot be pressed out, soon putrefies, and extensive inflammation and suppuration are the frequent consequences. A man, in going down one of the staircases, at the King's Bench, fell, and suffered a contusion over the sacrum, where a tumour, from effused blood, soon formed, almost as large as his head. The blood was completely absorbed in a few weeks, without any suppuration having taken place. Mild antiphlogistic treatment, cold evaporating lotions, and purgatives, were the only means employed. A man was brought into the North London Hospital, Oct. 1. 1836, with a lacerated wound of the scrotum, protrusion of both testes, a fracture of the right femur in its upper third, and a copious extravasation of blood from external violence applied to the left hip. The quantity of blood, effused after a time, was calculated to be not less than three or four quarts. I scarcely expected to succeed in dispersing the whole of it; yet, in about two months, every particle of it was absorbed.

The quick and powerful action of the absorbent vessels in removing extravasations of blood, can now be no longer called in question, when we daily see it proved in modern practice, that the largest aneurismal swellings are thus speedily diminished and removed, after the operation of tying the arteries, from which such tumours arise.

I wish, however, the preceding observations merely to convey a general condemnation of the practice of opening swellings containing extravasated blood; for no surgeon is more assured than I am, that there are particular exceptions, in which the plan is highly proper and necessary. Thus, whenever a case of extensive ecchymosis, or a large tumour of extravasated blood, either excites suppuration, or creates excessive pain from distention, it is better to practise a free opening. So it sometimes happens, in aneurism, that the skin breaks after the artery has been tied, and some of the blood escapes; but the remainder putrefies, and soon becomes blended with purulent matter in the sac. Here the making of a free incision for the discharge of the irritating contents of the swelling, with due attention to every caution, delivered in the article Aneurism, will often be followed by beneficial effects.

ECTHYMA (ἐχθυμιάω, *exhalo*, or from ἐχθύειν to break with fury). A term, employed by the ancients, and revived by Willan, to denote an inflammation of the skin, principally characterised by large or phlyzaceous pustules of the skin, in one or several regions of the body. The term *phlyzaceous* was applied by Willan to pustules, which are large, elevated on a hard circular base, of a bright red colour, and succeeded by a thick indurated scab, of a dark colour.

ECTROPIUM (from ἐκτρέπω, to turn). An eversion, of the eyelids.

One case is produced by an unnatural swelling of the lining of the eyelids, which not only pushes their edges from the eyeball; but also presses them so forcibly, that they become everted: another, arises from a contraction of the skin of the eyelid, or its vicinity, by which means the edge of the eyelid is first removed to some distance from the eye, and afterwards turned completely out, together with the whole of the affected eyelid.

The morbid swelling of the lining of the eyelids, which causes the first species of ectropium (putting out of present consideration a similar affection incidental to old age), arises mostly from a congenital laxity of this membrane, afterwards increased by obstinate chronic ophthalmies, particularly that of a scrofulous nature, in relaxed, unhealthy subjects; or else the disease originates from the small pox affecting the eyes.

While the disease is confined to the lower eyelid, as it most commonly is, its lining may be observed rising in the form of a semilunar fold, of a pale red colour, like the fungous granulations of wounds, and intervening between the eye and eyelid, which latter it in some measure everts. When the swelling is occasioned by the lining of both the eyelids, the disease assumes an annular shape, in the centre of which the eyeball seems sunk, while the circumference of the ring presses, and everts the edges of the two eyelids so as to cause both great uneasiness and deformity. In each of the above cases, on pressing the skin of the eyelids with the point of the finger, it becomes manifest, that they are very capable of being elongated, and would readily yield, so as entirely to cover the eyeball, were they not prevented by the intervening swelling of their membranous lining.

Besides the considerable deformity, which the disease produces, it occasions a continual discharge of tears over the cheek, and, what is worse, a dryness of the eyeball, frequent exasperated attacks of ophthalmy, incapacity to bear the light, and, lastly, opacity and ulceration of the cornea.

The second species of ectropium, or that arising from a contraction of the integuments of the eyelids, or neighbouring parts, is not unfrequently a consequence of puckered scars, produced by the confluent small-pox, deep burns, or the excision of cancerous, or encysted tumours, without saving a sufficient quantity of skin; or, lastly, the disorder is the effect of malignant carbuncles, or any kind of wound attended with much loss of substance. Each of these causes is quite enough to bring on such a contraction of the skin of the eyelids, as to draw these parts towards the arches of the orbits, so as to remove them from the eyeball, and turn their edges outward. No sooner has this circumstance happened, than it is often followed by another one equally unpleasant, namely, a swelling of the internal membrane of the affected eyelids, which afterwards has a great share in completing the eversion. The lining of the eyelids, though trivially everted, being continually exposed to the air, and irritation of extraneous substances, soon swells, and rises up, like a fungus. One side of this fungus-like tumour covers a part of the eyeball; the other pushes the eyelid so considerably outward, that its edge is not unfrequently in contact with the margin of the orbit. The complaints, induced by this second species of ectropium, are the same as those brought on by the first; and, in both cases, when the disease is inveterate, the fungous swelling becomes hard and callous.

In the first species of the disease, the skin of the eyelids and adjoining parts, is not deformed with scars; and by pressing the everted eyelid with the point of the finger, the part would with ease cover the eye, were it not for the intervening fungous swelling. But, in the second, besides the obvious cicatrix and contraction of the skin of the eyelids or adjacent parts, when an effort is made to cover the eye with the eyelid, by pressing upon the latter part with the point of the finger, it does not give way, so as completely to cover the globe, or it does not move in the least from its unnatural position, by reason of the integuments of the eyelids having been so extensively destroyed, that their margin is adherent to the arch of the orbit.

Mr. Guthrie enumerates a case, depending on chronic inflammation, accompanied with contraction of the integuments of the eyelid, but *without any manifest cicatrix.* It is described as usually taking place after a long continuance of *lippitudo*, and proceeding from the excoriation, contraction, and hardening of the skin, "the result of the passage of the vitiated secretions over it, and which, by dropping on it, increase the irritation." (*Operative Surgery of the Eye*, p. 50—55.) This form of the disease, is rarely attended with such a thickening of the inner membrane of the eyelid, as to need removal with the knife or scissors; for it subsides with the removal of the complaint. (P. 60.)

According to Scarpa, the cure of ectropium cannot be accomplished with equal perfection in both its forms, the second species being, in some cases, absolutely incurable. For, as in the first species of ectropium, the disease only depends upon a morbid thickening of the internal membrane of the eyelids, and the treatment merely consists in removing the redundant portion, art possesses many efficacious means of accomplishing what is desired. But, in the second species, the chief cause of which arises from the loss of a portion of the skin of the eyelids or adjacent parts, which loss no known artifice can restore, surgery is not capable of effecting a perfect cure. The treatment is confined to remedying, as much as possible, such complaints as result from this kind of eversion, and this can be done in a more or less satisfactory manner, according as the loss of skin is little or great. Cases, in which so much skin is deficient, that the edge of the eyelid is adherent to the margin of the orbit, Scarpa bandons as incurable. How far the case can be rectified, he thinks, may always be estimated by remarking to what point the eyelid admits of being replaced, on being gently pushed with the end of the finger, towards the globe of the eye, both before and after the employment of such means as are calculated to effect an elongation of the skin of the eyelid; for, it is to this point, and no further, that art can reduce the everted part, and permanently keep it so replaced.

When the first species of ectropium is recent, the fungous swelling of the lining of the eyelid not considerable, and, consequently, the edge of the eyelid not much turned out, and in young subjects (for in old ones the eyelids are so flaccid, that the disease is irremediable), Scarpa prefers destroying the fungous surface of the internal membrane of the eyelid by the repeated application of the argentum nitratum. Mr. Guthrie touches the fungous portion of the conjunctiva every four days, with a probe dipped in sulphuric acid, and gently applies every day, or every second day, the sulphate of copper, at the same time not omitting some minor remedies, which he also employs in cases proceeding from contraction of the skin independent of any cicatrix, and which I shall presently notice. (*Operative Surgery of the Eye*, p. 70.) In recent cases, where the patient is weak and irritable (or a child), Beer commences the treatment with simply applying every day the tincture of opium, which, after a time, is strengthened by the addition of naphtha. To the relaxed conjunctiva he afterwards applies escharotic eye-salves, and lastly, the nitrate of silver, and muriate of antimony. When the part is hard and callous, the caustic is preceded by scarifications. (*Lehre, &c.* b. ii. p. 136.)

For remedying the inveterate form of the first species of the disease, Beer and Scarpa are advocates for cutting away the whole of the fungous swelling closely from the inside of the eyelid. The following is Scarpa's description of the operation: —

The patient being seated, with his head a little inclined backward, the surgeon, with the index and middle finger of his left hand, is to keep the eyelid steadily everted; and holding a small pair of curved scissors with convex edges, in his right, he is completely to cut off the whole fungosity of the internal membrane of the eyelid, as near as possible to its base. The same operation is then to be repeated on the other eyelid, should that be affected with the same disorder. If the excrescence should be of such a shape, that it cannot be exactly included within the scissors, it must be raised with a forceps, or a double hook, and dissected off at its base, by means of a small bistoury with a convex edge. The bleeding stops of itself, or as soon as the eye has been bathed with cold water. The surgeon is then to apply two small compresses, one put on the upper, the other on the lower arch of the orbit, and over these the uniting bandage, in the form of the monoculus, or so as to compress and replace the edges of the everted eyelids, in order to make them cover the eye. On the first removal of the dressings, which should take place in twenty-four or thirty hours after the operation, the surgeon will find the whole, or almost the whole of the eyelid, in its natural position. The wound on the inside of the eyelid, should then be washed twice a day with simple water or barley-water. If, towards the end of the cure, it should assume a fungous appearance, or the edge of the eyelid seem to be too distant from the eyeball, the wound on the inside of the eyelid must be rubbed several times with the argentum nitratum, for the purpose of destroying a little more of the membranous lining, so that, when the cicatrisation follows, a greater contraction of it may take place, and the edge of the eyelid be drawn still nearer the eye.

In England, the excision of the fungous thickened portion of the conjunctiva, has mostly been relinquished for the employment of caustic. The difficulty of dissecting off every particle of the fungus renders the practice of excision less certain, than the treatment with caustic. Scarpa confesses its occasional failure, and the necessity of then having recourse to the latter plan. Demours also lets the employment of caustic follow the use of the knife. (*Mal. des Yeux*, p. 98.) In ectropium from a relaxed fungous state of the conjunctiva, the consequence of purulent ophthalmia, Dr. Vetch begins with a light careful application of the argentum nitratum to the whole granulated villous surface. The everted part is then to be returned, and secured in its place with a compress, and straps of plaster and a bandage. Every time the eye is cleaned, the same things are to be repeated, and, in the course of a few days, the tendency to protrude will disappear. (*On Diseases of the Eye*, p. 228.)

In the species of ectropium produced by an accidental contraction of the skin of the eyelids, or neighbouring parts, Scarpa observes, that, if a contraction of the integuments has proved capable of everting the eyelid, the excision of a piece of the internal membrane of the part, and the cicatrix which will follow, must also be capable, for the same reason, of bringing back the eyelid into its natural position. But, since nothing can restore the lost skin, the shortened state of the whole eyelid, in whatever degree it exists, must always continue, even after any operation the most skilfully executed. Hence the treatment of the second species of ectropium, will never succeed so perfectly as that of the first, and the replaced eyelid will always remain shorter than natural, in proportion to the quantity of integuments lost. It is true, that, in many cases, the eversion seems greater than it actually is, in regard to the small quantity of skin lost or destroyed; for, when the disease has once begun, though the contraction of the skin may be trivial, in consequence of the little quantity of it deficient, still the swelling of the lining of the eyelid, which never fails to increase, at last brings on a complete eversion of the part. In these cases, the cure may be accomplished with such success, as is surprising to the inexperienced; for, after the fungous swelling of the internal membrane of the eyelid has been cut off, and the edge of the part approximated to the eyeball, the shortening of the eyelid, remaining after the operation, is so trivial, that it may be considered as nothing, in comparison with the deformity and inconvenience occasioned by the ectropium. Whenever, therefore, the retraction of the skin of the everted eyelid, and the consequent shortness of it, are such, as not to prevent its rising again and covering the eye, if not entirely, at least moderately, Scarpa directs the surgeon to cut away the internal membrane of the everted eyelid, so as to produce a loss of substance on the inside of it. In inveterate cases of ectropium, in which the lining of the eyelids has become hard and callous, Scarpa applies to the everted eyelid for a few days before the operation, a soft bread and milk poultice.

The division of the cicatrices, which have given rise to the shortening and eversion of the eyelid, as Scarpa observes, does not procure any permanent elongation of this part, and consequently it is of no avail in the cure of the present disease. Fabricius ab Aquapendente, who well knew the inutility of making a semilunar cut in the skin of the eyelids, for the purpose of remedying their shortness and eversion, proposes, as the best expedient, to stretch them with adhesive plasters applied to them and the eyebrow, and tied closely together. Whatever advantage may result from this practice, the same degree of benefit may be derived from using, for a few days, a bread and milk poultice, afterwards oily embrocations, and, lastly, the uniting bandage, so put on as to stretch the shortened eyelid in an opposite direction to that produced by the cicatrix; a practice, which Scarpa thinks should always be carefully tried, before the operation is determined upon.

The surgeon, with a small convex-edged bistoury, is to make an incision of sufficient depth into the internal membrane of the eyelid, along the tarsus, carefully avoiding the situation of the puncta lachrymalia. Then, with a pair of forceps he should raise the flap of the divided fungous membrane, and continue to detach it, with the bistoury, from the subjacent parts, all over the inner surface of the eyelid, as far as where the membrane quits this part, to be reflected over the front of the eye, under the name of *conjunctiva*. The separation being thus far accomplished, the membrane is to be raised still more with the forceps, and cut off with one, or two strokes of the scissors, at the lowest part of the eyelid. The compresses and bandage to keep the eyelid replaced, are to be applied as above directed. On changing the dressings, a day or two after the operation, the eyelid will be found, in a great measure, replaced, and the disfigurement which the disease caused, greatly amended. The operation is rarely followed by bad symptoms, such as vomiting, violent pain, and inflammation. However, should they occur, the vomiting may be relieved by means of an opiate clyster, and, as for the pain and inflammation attended with great tumefaction of the eyelid operated upon, these complaints may be cured by applying a poultice, or bags filled with emollient herbs, at the same time employing internal antiphlogistics, until the inflammation and swelling have subsided, and suppuration has commenced on the inside of the eyelid, on which the operation has been done. After this, the treatment is to consist in washing the part twice a day, with water or barley-water, and lastly, in touching the wound a few times with the argentum nitratum, in order to keep the granulations within certain limits, and to form a permanent cicatrix, proper for maintaining the eyelid replaced.

Juengken describes a plan, which has been adopted by Jaeger himself, and was practised a hundred years ago by Platner (*Instit. Chir.* § 582.), and even recommended a century before this author, by our countryman, Bannister. Heister and Dionis notice it still more circumstantially. (See *Middlemore* on *Dis. of the Eye*, vol. ii. p. 787.) It consists in detaching the everted eyelid from the cheek, or superciliary ridge, at every point, excepting the angles, by introducing a sharp-pointed double-edged knife, through the conjunctival surface, near the inner angle, bringing it out through the skin, and conveying it across to the outer angle. A portion of the thickened conjunctiva, or a triangular piece of the lid, may be first removed, if necessary. The detached lid is then to be accurately fixed, in contact with the globe, and the skin of the cheek drawn towards the eye, and kept in that position with adhesive plaster, compresses, and bandage. (*Handbuch, &c.* p. 696.) Dieffenbach makes an incision through the skin and orbicularis, nearly parallel to the edge of the lower lid, beginning two or three lines from one angle, and terminating at the same distance from the other. It is one line from the edge of the lid at its two ends, and two or three lines in the middle. He turns up the small flap of skin, and dissects through the lid to the conjunctiva, which he divides to the extent of the external wound. With a hook, he draws the external margin of the divided conjunctiva into the wound of the skin, and keeps it and the integuments together with sutures. (See *Chir. Erfahrungen über die Wiederherstellung Zerstorter Theile, &c. von J. F. Dieffenbach*, p. 127. Berlin, 1830.)

In cases in which the eversion is considerable, Sir W. Adams never found the simple excision of the fungus sufficient to effect a radical cure, and he therefore tried a new mode of operating. In his first attempts, he employed a small curved bistoury, the point of which he carried along the inside of the eyelid, at its outer angle, downwards and outwards, as far as the point of reflection of the conjunctiva would admit. He then pushed it through the whole substance of the everted eyelid and its integuments, and cut upwards through the tarsus, making an incision nearly half an inch in length. With a curved pair of scissors, he next snipped off a piece of the edge of the tarsus, about one-third of an inch in width, and he afterwards removed with the same instrument the whole of the diseased conjunctiva. When the bleeding had ceased, Sir W. Adams passed a needle and ligature through the whole substance of the two divided portions, and brought them as accurately into contact as possible. Finding, however, that too much integument had been left at the lower part of the incision, he employed, in future operations, instead of the scalpel, a pair of straight scissors, with which he cut out an angular piece of the lid, resembling the letter V, with its broad interval towards the ciliary edge of the lid. Latterly, Sir W. Adams found it advantageous to leave about a quarter of an inch of the lid adjoining its external angle; and after shortening the part as much as necessary, he brought the edges of the incision together with a suture. (See *Practical Obs. on Ectropium, &c.* p. 4 and 5. Lond. 1812.)

That this operation will cure the ectropium, caused by the contraction of cicatrices, or produce great improvement, the expereience of Mr. Travers confirms. (*Synopsis of the Diseases of the Eye*, p. 235.) Mr. Guthrie also acknowledges, that it may be highly useful in the ectropium from the contraction of a cicatrix. (*On the Operative Surgery of the Eye*, p. 71.) The contracted scar must be divided, in addition to the other proceedings.

In the form of ectropium, arising from a hardened and contracted state of the integuments of the eye, but without any cicatrix, the indications seem to Mr. Guthrie to be; 1st, To relieve the contraction of the skin externally; 2dly, To restore and retain the eyelid in its proper situation, until the unnatural curvature of the cartilage has been overcome, and the chronic inflammation removed. For fulfilling the first indication, he recommends washing the external parts with warm water, so as to leave the skin as clean as possible. It is then to be carefully dried, and repeatedly anointed with the ung. zinci, for three or four days. Being thus protected from the irritation, it becomes softer, and in a favourable state to yield to mild extension. For accomplishing the second indication, Mr. Guthrie applies the sulphuric acid; the eyelid having been cleansed so as to prevent its slipping, the conjunctiva is to be gently wiped dry, and everted as much as possible, so that the part where it begins to be reflected over the eyeball may be seen. An assistant is to raise the upper eyelid a little, and the patient to look upwards. The blunt end of a common silver probe is then to be dipped in the sulphuric acid, and rubbed over the conjunctiva, so that every part of it may be touched with the acid. The round point of the probe is to be carried as far as where the membrane begins to be reflected over the eyeball, but no further. The punctum lachrymale, caruncle, and semilunar fold, are to be avoided; but, the external angle, as well as every other part, except what is reflected over the eye, is to be carefully rubbed. The acid will turn the touched portion of the conjunctiva white; and in order to prevent the acid from affecting the eyeball, a stream of water is now to be directed over the eyelid with an elastic gum syringe. If the conjunctiva should not be turned sufficiently white, the application may be repeated. The use of the acid is to be repeated every fourth day; "and, when applied in the manner directed, it does not cause a slough, but a general contraction of the part, which is, however, only perceptible after two or three applications, by its effect in inverting the lid, which gradually begins to take place. After six or eight applications, the cure will be more than half accomplished, and, in most cases of this species of eversion, the thickening of the conjunctiva will have subsided." The ung. zinci is to be constantly applied to the skin, and the ung. hydrarg. nitr. in the proportion of one part to four or six of the ung. cetacei, to the edge of the eyelid. After the eyelid has returned two-thirds of the way towards its natural position, the intervals between the applications of the acid must be longer, lest the contraction within the eyelid be carried too far, and an inversion of it produced. After the eversion has been cured, the lippitudo may yet partly remain, and demand the use of the ung. hyrdrarg. nitr. or other gentle stimulants.

See *Scarpa*, Osservazioni sulle Malattie degli Occhi; ed. 5. cap. vi. *Richter*'s Anfangsgr. der Wundarzneykunst, b. ii. p. 473., &c. *Pellier*, Recueil d'Obs. sur les Maladies des Yeux. Sir *W. Adams*, Pract. Observ. on Ectropium, or Eversion of the Eyelids, with a Description of a new Operation for the Cure of that Disease; on the Modes of forming an artificial Pupil; and on Cataract, 8vo. Lond. 1812. *M. Bordenave*, Mémoire dans lequel on propose un nouveau Procédé pour traiter le Renversement des Paupières, in Mém. de l'Acad. Royale de Chirurgie, t. xiii. p. 156. et seq. édit. 12mo. It was in this memoir, that the proposal of removing a portion of the inside of the eyelid for the cure of ectropium was first made. *P. J Roux*, Parallèle de la Chirurgie Anglaise avec la Chirurgie Française, p. 289—292. Paris, 1815. *G. J. Beer*, Lehre von den Augenkrankheiten, b. ii. p. 133. &c. 8vo. Wien, 1817. *Benj. Travers*, Synopsis of the Dis. of the Eye, p. 234. 356. &c. 8vo. Lond. 1820. *Demours*, Traité des Mal. des Yeux, p. 98. *G. J. Guthrie*, Lectures on the Operative Surgery of the Eye, 8vo. Lond. 1823. *Wm. Lawrence*, On Diseases of the Eye, p. 349, 8vo. Lond. 1833. *Wm. Mackenzie*, On Dis. of the Eye, p. 207. ed. 2. 8vo. Lond. 1833. *R. Middlemore* on Dis. of the Eye, vol. i. p. 120.; vol. ii. p. 782. 8vo. Lond. 1835.

ECZEMA, or Ecze´sma, (from ἐκζέω, to boil out,) is characterised by an eruption of small vesicles on various parts of the skin, usually close, or crowded together, with little or no inflammation round their bases, and unattended by fever. It is not contagious. (*Bateman's Synopsis*, p. 250. ed. 3.) There are several varieties of this disease, the most remarkable of which is the *eczema rubrum* from the irritation of mercury. This form is attended with quickened pulse and a white tongue; but the stomach and sensorium are not materially disturbed. (See Mercury.)

EFFUSION, in surgery, means the passage of any fluid out of the vessel, or viscus, naturally containing it, and its lodgment in another cavity, the cellular tissue, or the substance of parts. Thus, when the chest is wounded, blood is sometimes effused from the vessels into the cavity of the pleura; in false aneurism, the blood passes out of the artery into the cellular tissue; in retention of urine, this fluid after a time, flows from the bladder and urethra into the cellular tissue of the perineum and scrotum; and, when great violence has been applied to the skull, blood is often effused upon, or in the substance of, the brain. Effusion also sometimes signifies the separation of fibrine, or a serous fluid from the vessels by the process of secretion, or some action of the vessels analogous to it. (See Extravasation.)

ELECTRICITY. Among the aids of surgery, electricity once held a conspicuous and important situation. It has, however, met with a fate, not unusual with remedies too much cried up and too indiscriminately employed; that of having fallen into an undeserved degree of neglect. Whatever its effects may be on the system, it certainly possesses this advantage over other topical remedies, that it may be made to act on parts very remote from the surface. Electricity, as a topical remedy, for surgical diseases is chiefly tried in amaurosis, deafness, some chronic tumours, and abscesses, weakness from sprains, or contusions, paralysis, &c. In suspended animation, electricity is sometimes an important auxiliary for the restoration of the vital functions. (See *J. Curry's Obs. on Apparent Death, &c.* ed. 2. 1815.)

ELEVATOR. An instrument for raising depressed portions of the skull. Besides the common elevator, now generally preferred by all the best operators, several others have been invented; as, for instance, the tripod elevator, and another, which was first devised by J. L. Petit, and afterwards improved by M. Louis.

EMBROCATION. (See Linimentum.)

EMBRYOTOMIA. (from ἔμϐρυον, the fœtus, and τέμνω, to cut.) The operation of cutting into the womb, in order to extract the fœtus. (See Cæsarean Operation.)

EMPHYSEMA. (ἐμφύσημα, from φυσάω, to inflate.) A swelling produced by the presence of atmospheric air, or of any other gaseous fluid, which has insinuated itself into, or been formed in, the cellular tissue. Emphysematous swellings are divided into two classes; one, the *traumatic*, in which they originate from a wound of some part of the organs of respiration; and another, the *idiopathic* or *spontaneous* where they proceed either from chemical decomposition, or from secretion or internal pathological causes, the nature of which is obscure. In the latter class have been arranged *emphysema of the lungs*, a subject, on which the researches of Laennec threw important light; and certain cases, where, in consequence of inflammation, gas is found under the mucous membrane of the digestive canal. (See *L. J. Bégin* in *Dict. de Méd. et de Chir. Pratiques*, t. vii. art. *Emphysème*.)

With regard to *traumatic emphysema*, or that originating from a breach in the air-passages, sometimes it arises from a manifest, or concealed wound of the lungs, bronchi, trachea, or larynx; sometimes it follows a rupture of the air cells, or passages, by the air itself. One common cause is a fractured rib, by which the air vesicles of the lungs are wounded, so that the air escapes from them into the cavity of the thorax. But, as the rib, at the moment of its being fractured, is pushed inwards, and wounds the pleura, which lines the ribs and intercostal muscles, part of the air most commonly passes through the pleura, into the cellular tissue, on the outside of the chest, and thence is diffused through the same over the whole body, so as to inflate it sometimes in an extraordinary degree.

Emphysema is frequent after a fractured rib, because there is a wide laceration of the lungs, and no exit for the air; it is less frequent in large wounds with a knife, or broad sword, because the air has an open and unimpeded issue; it is again more frequent in deep stabs with bayonets, or small swords; and it often follows gunshot wounds of the chest, particularly those in which the ribs are splintered. (See *J. Bell on Wounds of the Breast*, p. 265.)

If the lungs be deeply or extensively wounded by a portion of broken rib, or sternum, as there is in such a case no passage for the air outwards through any external wound in the chest, emphysema is very likely to arise, and to proceed to a dangerous degree.

Emphysema has also been known to arise from a rupture of the larynx and trachea, produced by a blow, or kick, as is exemplified in the case reported by Dr. L. O'Brien. (See *Edin. Med. and Surg. Journ.* No. lxxii.)

The emphysematous swelling, wheresoever situated, is easily distinguished from œdema, or anasarca, by the crepitation which occurs on handling it, or a noise, like that which takes place on compressing a dry bladder half filled with air. The tumour is colourless and free from pain. It does not of itself descend into depending parts, though by pressure it may be made to change its situation. It is elastic, that is to say, it may be pressed down, but it rises up again as soon as the pressure is discontinued. The swelling never retains the impression of the end of the finger, or, in the language of surgery, never *pits*. The part is not heavy. The tumour first makes its appearance in one particular place; but soon extends, and causes an extraordinary distension of the skin. (*Richter's Anfangsgr. der Wundarzn.* b. i. p. 451.)

In bad cases, the patient complains of a considerable tightness of the chest, with pain, chiefly in the situation of the injury, and great difficulty of breathing. This obstruction of respiration gradually increases, and becomes more and more insupportable. The patient soon finds himself unable to lie down in bed, and cannot breathe, unless when his body is in the upright posture, or he is sitting a little inclined forward. In vain, he endeavours to articulate a few words; at each inspiration, a fresh column of air escapes from the breach in the lung, and renders his condition worse. Together with these symptoms, there is sometimes bloody expectoration, announcing a deep penetration of the lungs. (See *Case by Dupuytren*, in *Clin. Chir.* t. i. p. 117.) The countenance becomes red and swollen. The pulse, at first weak and contracted, becomes afterwards irregular. The extremities grow cold; and, if the patient continue unrelieved, he soon dies suffocated.

The diagnosis is not always free from obscurity, especially when emphysema is deeply seated, without any external tumour. An accumulation of air in one of the cavities of the pleura, however, is attended with an elevation and expansion of the ribs on the injured side; a clear sound on percussion; and excessive difficulty of breathing. In one example, where the fifth and sixth ribs were broken, there was, in addition to other symptoms already enumerated, an internal hissing sound at each expiration. (*Bégin, Dict. de Méd. et de Chir. Pratiques*, t. vii. p. 117.) For other symptoms and signs of the presence of air in the cavities of the pleura, see Pneumo-thorax.

The wound of the pleura and intercostal muscles may sometimes be too small to suffer the air to get readily into the cellular tissue, and inflate it; but may confine a part of it in the cavity of the thorax, so as to compress the lungs, prevent their expansion, and cause the same symptoms of tightness of the chest, quick breathing, and sense of suffocation, which the serous fluid does in hydrops pectoris or matter in empyema. (*Hewson, in Med. Obs. and Inq.* vol. iii.)

To understand, why the air passes at all out of the wound of the lungs, we must advert to the manner, in which inspiration and expiration are naturally carried on. In the perfect state, the surface of the lungs always lies in close contact with the membrane lining the chest, both in inspiration and expiration. The lungs themselves are chiefly passive organs, and incapable, by any action of their own, of expanding and contracting, so as to maintain their external surface always in contact with the inside of the thorax, which is continually undergoing an alternate change of dimensions. Every muscle, that has any share in enlarging and diminishing the capacity of the chest, must contribute to the effect of adapting the volume of the lungs to the cavity in which they are contained, so long as there is no communication between the cavity of the pleura, and the external air. In inspiration, the thorax is enlarged in every direction; the lungs are expanded in the same way; and the air, entering through the windpipe into the air-cells of these organs prevents the occurrence of a vacuum.

But, when a free communication exists between the atmosphere and inside of the chest, in consequence of a wound, no sooner is this cavity expanded, than the air naturally enters it at the same time, and for the same reasons, that the air enters the lungs through the trachea, and the lung itself remains proportionally collapsed. When the thorax is next contracted, in expiration, the air is compressed out of the lung, and also out of the sac of the pleura, through the external wound, if there be a direct one; in which circumstance, the emphysematous swelling is never extensive.

But, in the case of a fractured rib, attended with a breach in the pleura costalis, pleura pulmonalis, and air-cells of the lungs, there is no direct communication between the cavity of the chest and the external air; in other words, there is no outward wound in the parietes of the thorax. There is, however, a preternatural opening formed between the air-cells of the lungs and the cavity of the chest, and also another one between the latter space, and the general cellular tissue of the body, through the breach in the pleura costalis. The consequence is, that when the chest is expanded in inspiration, air rushes from the wound in the surface of the lungs, and insinuates itself between them and the pleura costalis. The lungs collapse in proportion, and the place which they naturally occupied, when distended, is now occupied by the air. When, in expiration, the dimensions of the chest are every where diminished, the air, now lodged in the sac of the pleura, cannot get back into the aperture in the collapsed lung, because this is already full of air, and is equally compressed on every side, by that which is confined in the thorax. Were there no breach in the pleura costalis, this air could not now become diffused; the muscles of inspiration would next enlarge the chest, remove the pressure from the surface of the wounded lung, more air would be sucked out of it, as it were, into the space between the pleura costalis and pleura pulmonalis, and this process would go on, till the lungs of the wounded side were completely collapsed. But, in the case of a fractured rib, or narrow stab, in which there is also a breach in the pleura costalis, without any free vent outward, for the air, which gets out of the lung into the cavity of the pleura, as soon as the expiratory powers lessen the capacity of the chest, this air, not being able to pass back through the breach in the collapsed lung, is forced through the laceration, or wound, in the pleura costalis, into the cellular tissue.

It is through the communicating cells of this structure, that the air becomes most extensively diffused over the whole body, in proportion as the expiratory muscles continue in their turn to lessen the capacity of the chest, and pump the air, as it were, through the breach in the pleura costalis, immediately after it has been drawn out of the wound of the lung in inspiration. (See *John Bell on Wounds of the Breast, and Halliday on Emphysema*, 1807.)

When organised adhesions exist between the pleura costalis and pleura pulmonalis, so as to establish a continuity of textures between the surface of the lungs, and the parietes of the chest, the comprehension of the mechanism of emphysema is, as Dupuytren remarks, assuredly perfectly simple. The air then passes directly from the interior of the lungs into new-organised cellular texture, and thus gets through the parietes of the injured side into the subcutaneous cellular tissue. When there are no adhesions, a part of the air escapes, during inspiration, from the opening in the surface of the lung, and then becomes diffused in the surrounding textures and the cavity of the pleura. Thence, it is forced in all directions, as Dupuytren conceives, both by the alternate movements of expansion and contraction of the chest in respiration, and by the effect of its own elasticity; and it is made to enter progressively the cellular tissue of all the internal and external organs. Thus, if the quantity of air, drawn out of the lung, is considerable, it passes not only into the parietes of the chest and belly, the upper and lower extremities, the interior of the scrotum, the neck and head, but also into the cavity of the pleura, the two mediastina, the pericardium itself, and even into the interlobular cellular tissue of the lungs themselves. (See *Dupuytren, in Clin. Chir.* t. i. p. 113. 119.) In some cases, emphysema is the principal disorder; in others, it is only one of secondary importance, and sometimes not readily ascertained. An example, illustrating this fact, is given by Dupuytren, where the upper fragment of a broken sternum had penetrated the pericardium, and torn the right ventricle of the heart; and where a considerable quantity of bloody serum and of black blood itself was effused in the right cavity of the pleura; the fourth, fifth, and sixth ribs broken; and their cartilages separated from the sternum. (*Ib.* p. 120.) A case, published by M. Littre, well illustrates the enormous distention of the cellular tissue, occasionally produced: on the chest, the swelling was eleven inches thick; on the belly, nine; on the neck, six; and four on other parts. (See *Mém. de l'Acad. des Sciences,* 1713.)

To prove that the confinement of air in the chest is the cause of the dangerous symptoms attending emphysema, Hewson adverts to the histories of some remarkable cases, published by Littre, Mery, W. Hunter, and Cheston. (See *Mém. de l'Acad. Royale des Sciences, for* 1713; *Med. Obs. and Inquiries,* vol. ii.; and *Pathological Inquiries.*) The same eminent man made several experiments on animals, tending to prove that air in their chests produced great difficulty in breathing, such as occurs in emphysema; and, in one case, which he examined after death, air was actually discharged on puncturing the thorax.

While none of the symptoms denote the extension of emphysema to internal organs; and the quantity of air does not exceed a few cubic inches, the patient is not in danger, so far as this disorder is concerned. But the case is very different, when the air has passed not only into all the subcutaneous cellular tissue, but also into that of the internal organs of the chest, and even those of the abdomen; and when, besides such distention of the cellular tissue generally, there is likewise an accumulation of air in the great serous cavities. (See *Dupuytren, Clin. Chir.* t. i. p. 112.)

The passage of air into the subcutaneous, or intermuscular cellular tissue, occurs, not only as a complication of fractures, or penetrating wounds of the chest, but in any region adjacent to the air passages, or cavities. M. Carré has published an instance of air ascending the nasal duct, and rupturing one of the lachrymal canals, when the patient blew his nose. (See *Mém. de Méd. Milit.*) One case of emphysema of the eyelids from a presumed fracture of the horizontal plate of the ethmoid bone, or os unguis, and another from a supposed laceration of the pituitary membrane, used to be related by Dupuytren in his lectures. He also gives the particulars of an emphysema of the temporal region from a fracture of the frontal sinus. In all these examples of emphysema from injury of the upper parts of the respiratory apparatus, the surgeon will notice, in addition to the crepitation, &c., a sudden increase of the swelling whenever the patient coughs, or blows his nose. (Vol. cit. p. 123—130.) Here the treatment consists in bleeding, cold astringent lotions, and the avoidance of every thing calculated to make the air escape through the breach into the cellular issue.

The object of Mr. Hewson's paper is to recommend making an opening in the chest, for the purpose of giving vent to the air confined in that cavity, just as is done for the discharge of pus, in empyema, or of a serous fluid, in hydrops pectoris.

In wounds of the lungs, says this author, whether occasioned by fractured ribs, or other causes, when symptoms of tightness and suffocation come on, so far should we be from dreading the emphysematous swelling of the cellular tissue, that we should rather consider it as a favourable symptom, showing that the air is not likely to be confined in the thorax; and so far should we be from compressing the wound to prevent the inflation, or emphysema, that we should rather dilate it (if not large enough already) or perform paracentesis thoracis. We may judge of the necessity of this operation from the violence of the symptoms, such as the oppressed breathing, &c. For when these are not considerable, and the air passes out of the chest with sufficient freedom, the operation is then unnecessary.

If the disease is on the right side, the best place for performing the operation, says Mr. Hewson, will be on the fore part of the chest, between the fifth and sixth ribs; for, there the integuments are thin, and, in the case of air, no depending drain is required. But, if the disease is on the left side, it will be more advisable to make the opening between the seventh and eighth, or eighth and ninth ribs, in order that we may be sure of avoiding the pericardium. As large penetrating wounds are inconvenient on account of the air entering by the aperture in such a quantity *as to prevent the expansion of the lungs,* a small wound will be eligible, especially as air does not require a large one for its escape. Mr. Hewson recommends dissecting cautiously with a knife, in preference to the coarse and hazardous method of thrusting in a trocar.

There is one error in Hewson's paper, for which he has been justly criticised by John Bell; viz. the idea, that it is possible and proper to make the collapsed lung expand by making an opening in the chest. Bromfield and B. Bell imbibed the same erroneous opinion, and proposed plans for exhausting the air and expanding the lung. It is certain that it is impracticable to make the collapsed viscus expand, until the breach of it is closed, and this closure is greatly promoted by the quiet state, in which the collapsed lung remains; a state, also, the most favourable for the stoppage of any bleeding from the pulmonary vessels.

The true object then of making an opening in the thorax, when the symptoms of suffocation are violent, is not to obtain an expansion of the lung on the affected side, nor to take the pressure of the air from it; but, to remove the pressure caused on the opposite lung by the distention of the mediastinum, and, at the same time, to diminish the pressure of the air on the diaphragm. The lung on the affected side must continue collapsed, and it is most advantageous that it should do so. The opposite lung is that, which for a time must of itself carry on respiration, and it is known to be fully adequate to the function, provided the quantity of air, on the other side of the chest, does not produce too much pressure on the mediastinum, and diaphragm.

Mr. John Bell concludes his remarks on this subject, with advising the following practice:—

1st. When the crackling tumour begins to form over a fractured rib, small punctures should be made with the point of a lancet, as in bleeding; and if the point be struck deep enough, the air will rush out audibly. But, as (supposing the lung is not adherent to the inside of the chest) this air was in the thorax, before it came into the cellular tissue, it is plain, that the thorax is still full, and that the lung of that side is already collapsed and useless, and must continue so. The purpose, therefore, of making these scarifications, and, especially, of making them so near the fractured part, is not to relieve the lungs, but merely to prevent the air spreading more widely beneath the skin.

2dly. If the air should have spread to very remote parts of the body, as to the scrotum, and down the thighs, it will be easier to make small punctures in those parts, to let out the air directly, than to press it along the whole body, till it is brought up to the punctures made on the chest, over the wounded part.

3dly. If, notwithstanding free punctures, and pressing out the air in this way, it is found by the oppression, that either air, or blood, is accumulating within the cavity of the thorax, so as to oppress, not the wounded lung only, which was of course collapsed and useless from the first, but the diaphragm, and through the diaphragm to affect also the sound lung; then a freer incision must be made, through the skin and muscles, and a small puncture should be cautiously made through the pleura, in order to let out the air, or blood, confined in the thorax. (*John Bell, Op.* cit. p. 278.)

I believe, with Dupuytren, that making cuts, or punctures in the skin, will be of little service where emphysema is attended with urgent symptoms depending upon the accumulation and confinement of air in internal cavities and organs, though the practice may answer the purpose of preventing the further diffusion of air in the subcutaneous cellular tissue by affording an outlet for it. Hence, if the case be not too far advanced, or joined with complications beyond the reach of surgery, Dupuytren was not adverse to the plan. (See *Clin. Chir.* t. i. p. 117.)

Sometimes the necessity for puncturing the pleura is rendered obvious by the oppressed state of the breathing, and other urgent symptoms of pneumo-thorax; but, from the extreme distension of the integuments it is difficult to ascertain on which side the operation should be performed. In one instance upon record, an incision was made between the sixth and seventh ribs on the left side; every symptom became immediately worse, and death followed in a quarter of an hour. The *post mortem* examination shewed, that the operation had been performed on the wrong side. (See *Halliday on Emphysema.*) In traumatic cases, or those from fractured rib, I think that such difficulty is not likely to happen; the wound, or fracture being a guide.

In all these cases, copious and frequently repeated venesection is generally proper.

After a few days, the wound in the collapsed lung, is closed by the adhesive inflammation, so that air no longer passes out of it into the cavity of the chest, and the outer wound may therefore be healed. What air is already there is ultimately absorbed, and the lung, expanding in proportion, resumes its original functions.

The application of a bandage round the chest is sometimes practised for the relief of emphysema; and its utility, when the ribs are broken, has been highly spoken of by Mr. Abernethy. "Pressure by bandage (says he) not only hinders the air from diffusing itself through the cellular substance, but serves to prevent it from escaping out of the wounded lung; and, of course, facilitates the healing of the wound, which would be prevented by the constant transmission of air. Its early application, therefore, will often prevent a very troublesome symptom, whilst, at the same time, by keeping the fractured bones from motion, it greatly lessens the sufferings of the patient." (*Abernethy's Surgical Works*, vol. ii. p. 179.) When emphysema is complicated with a fractured rib, the latter injury is unquestionably a reason in favour of a bandage. But, whether the pressure of the roller will be useful, or hurtful, with respect to the emphysema itself, or the state of the lungs and respiration, may be questionable. As for its tendency to resist the diffusion of air in the cellular tissue, this circumstance does not appear to me important; because the air, thus diffused, much as it disfigures the patient, is nearly harmless, at least so long as the great serous cavities, and the interlobular texture of the lungs remain uninflated; a danger, also, which no bandaging has any tendency to prevent. Neither will a bandage have so much effect in hindering the diffusion of air, as scarifications, with this important additional consideration, that punctures, or small incisions, made over the broken rib, prevent the spreading of the air, by letting it escape, while a bandage can only do so by more or less resisting its escape from the cavity of the pleura; which mode of operation in some cases would dangerously interfere with the continuation of respiration by the lung of the opposite side. At the same time, I believe, that when the air extravasated within the injured side of the chest is not in such quantity as to oppress the sound lung, and a rib is broken, a bandage will generally afford great relief. Indeed, it is but justice to Mr. Abernethy to state, that he does not recommend the employment of a bandage in all cases of emphysema. "Patients (says he) will not always be able to wear a bandage, when one lung is collapsed, particularly if any previous disease has existed in the other, as it equally confines the motions of the ribs on both sides, and as every possible enlargement of the chest becomes necessary for the due admission of the air into the lung, which still executes its functions. Under these circumstances, if the emphysema continues (and its continuance must always denote that the wound in the lung is not closed), I should esteem it the best practice to make a small opening into the chest, so that the external air might have a free communication with that cavity; and then the injured lung must remain motionless till its wound is healed, and the mediastinum, will, in every state of the thorax, preserve its natural situation." (*Abernethy*, vol. cit. p. 183.) In the case recorded by Cheston, the patient on having a compress and bandage applied, exclaimed that he could not endure it.

When emphysema was combined with a fractured rib, and not any urgent compression of the lungs by air in the cavity of the pleura, Dupuytren used to bleed, apply to the injured side compresses wetted with a resolvent lotion, and then surround the chest with a bandage, so as to suspend the action of the external muscles of respiration, and oblige the patient to breathe entirely by the diaphragm, the principle insisted upon by Abernethy. In this manner, the union of the fracture was promoted; and, as was believed, the causes of emphysema opposed. The possibility of a person breathing wholely by the diaphragm seemed proved to Dupuytren by what happens in injuries of the upper part of the spinal chord, when all the external muscles are struck with paralysis. (*Clin. Chir.* t. i. p. 115.) When, however, the respiration was dangerously interrupted by the accumulation of air in the pleura, Dupuytren abstained from applying a bandage, which, he conceived to be only likely to augment the patient's sufferings. (See *Clin. Chir.* t. i. p. 117.)

The utility of a free incision, and scarifications, is well illustrated in a case recorded by Larrey. The emphysema arose from a wound of the lungs by a lance. The whole body was prodigiously swelled; the integuments so distended, that the limbs were inflexible, the eyes buried; and the lips so enlarged that nothing could be introduced into the mouth. The pulse and respiration were scarcely perceptible, and the voice feeble and interrupted. The lance had entered obliquely under the lower angle of the scapula; and though the external and internal orifices of the wound were not parallel, the surgeon had applied adhesive straps, and closed the external one. Hence, the air, as it escaped from the lungs, distended the cellular tissue. Larrey immediately removed the dressings; and, with a bistoury made the openings in the pleura and skin parallel. Cupping glasses were then applied over the wound, and quickly filled with air and blood. The lips of the wound were now brought together, and kept so with a suitable bandage. Cupping glasses and scarificators were applied to various parts of the body, and, in others, incisions were made with a scalpel. The patient recovered. (See *Mém. de Chir. Militaire*, t. iv.)

In emphysema, dependent upon over distention and rupture of the air cells, and the escape of air into the interlobular tissue of the lungs, and thence, through the mediastinum, into the common cellular tissue, the best practice is that of diminishing the violence of the respiratory efforts, by which the air is forced at each respiration into the mediastinum. With this view, copious venesection should be employed, for the double purpose of relieving the pulmonary congestion, and of diminishing the mass of circulating fluid; for, by lessening the quantity of blood for oxygenation, we also lessen the necessity for taking in so large a supply of air for the purpose, and, in the same proportion, diminish the efforts made by the muscles of respiration to dilate and contract the thorax. Opiates should be employed with the same intent; and the antiphlogistic regimen enforced. (See *Townsend* in *Cyclop. of Pract. Medicine*, art. Emphysema; and *Laennec on Dis. of the Chest*, ed. by Forbes.)

Emphysema has been known to arise from the bursting of a vomica, and ulceration of the surface of the lungs; but, the air, which escapes cannot pass into the cavity of the thorax, because the inflammation, which precedes the abscess and ulceration of the air-cells, closes those which are adjacent, and produces an adhesion of the edges of the vomica, or ulcer, to the inner surface of the chest, so as entirely to separate the two cavities. Palfyn and Dr. Hunter met with cases, in which emphysema originated from abscesses of the lungs, attended with adhesion to the pleura and ulcerations in the situation of such adhesion. In these instances, the pus having made its way through the pleura and intercostal muscles, the air escaped through the same track, and passed into the cellular tissue on the outside of the chest.

A violent effort of respiration has sometimes produced a certain degree of emphysema, which first makes its appearance about the clavicles, and afterwards spreads over the neck and adjacent parts. The efforts of labour have been known to occasion it. (*Medical Comunications*, vol. i. p. 176.; *Blackden, in Med. Facts and Experiments*, vol. ii.; *Wilmer's Obs. in Surgery*, p. 143.; and *Halliday on Emphysema*.)

Dr. Johnson, of Dublin, met with six examples of this in his practice. In general, the emphysematous swelling is confined to the neighbourhood of the throat, where it first makes its appearance; but it may spread to a vast extent, and even to the very tips of the fingers. In hooping cough, emphysema may be produced as proved by the observations of Drs. Johnson, Mackintosh, and Beattie. (See *Cyclop. of Pract. Med.* art. Emphysema.) I agree with the writer of this article in thinking it highly probable, that many cases of emphysema supposed to be spontaneous, really proceed from a rupture of the air-cells of the lungs. Thus, besides the emphysema, which sometimes appears on the sides of the thorax when much force is employed to reduce a dislocation of the humerus, which was believed by Desault to depend upon a rupture of the air-cells, caused by the violent efforts, which the patient makes to hold his breath during the reduction of the dislocation, the emphysematous swellings, which are noticed occasionally, in hysteria, may admit of similar explanation, the air being forced through the cellular tissue of the lung and mediastinum by the violent efforts at expiration made during the paroxysm, while the glottis is spasmodically constricted. (*Townsend, ib.*)

Louis described an emphysema, which, on account of its cause, and the indication furnished by it to the practitioner, is highly important. It took place in a young girl, who died suffocated from a bean falling into her windpipe; and he considers it, though not correctly, as a pathognomonic symptom of such an accident, concerning the existence of which it is so essential not to commit any mistake. (See Tracheotomy.) It made its appearance on both sides of the neck, above the clavicles, and came on suddenly, on the third day after the accident. The inspection of the body proved, that the lungs and mediastinum were also in an emphysematous state. The retention of the air, confined by the foreign body, produced, says Louis, at each attempt to expire, and, especially, when the violent fits of coughing occurred, a strong propulsion of this fluid towards the surface of the lung, into the spongy substance of this viscus. Thence, the air passed into the cellular texture, which unites the surface of the lung to the pleura pulmonaris; and, by communications from cells to cells, it caused a prodigious swelling of the cellular tissue, between the two layers of the mediastinum. The emphysema, increasing, at length made its appearance above the clavicles. This tumefaction of the lung, and surrounding parts, in consequence of air getting into their spongy and cellular texture, is an evident cause of suffocation, and the swelling seems so natural an effect of the presence of a foreign body in the trachea, that one can hardly fail to think it an essential symptom, though no author has made mention of it. (*Mém. de l'Acad. de Chir.* t. iv. in 4to.) The emphysematous swelling, sometimes formed in the axilla, in the reduction of a dislocated shoulder was accounted for by Desault and Bichat, on the same principle as the foregoing case, viz. a rupture of one of the air-cells, by the patient's efforts to hold his breath during the reduction of the bone.

The example, lately recorded by Dr. Ireland, as one of idiopathic emphysema following pneumonia, bears so strong a resemblance to the case above cited from M. Louis, that I cannot refrain from suspecting, that it may have been one of the same nature. (See *Trans. of the King's and Queen's College of Physicians*, vol. iii. art. 4.)

An emphysematous swelling of the head, neck, and chest, has also been noticed in typhoid fevers. Dr. Huxham relates an instance of this sort, in a sailor of a scorbutic habit. (*Medical Obs. and Inquiries*, vol. iii. art. 4.) Another example in a case of bilious fever, is on record. (See *London Med. Repository*, No. 73.) A case of spontaneous emphysema is likewise described by Dr. Baillie. (See *Trans. for the Improvement of Med. and Chir. Knowledge*, vol. i. p. 202.)

A curious example of what has been called a spontaneous emphysema, is reported by Mr. Allan Burns: — "The patient was a strong athletic man, who, about six years previous to his application at the Royal Infirmary, had received a smart blow on the neck from the keel of a boat. This injury was soon followed by the formation of a firm tense tumour, on the place which had been hurt. The swelling increased very slowly, during the five years immediately succeeding its commencement; but, during the sixth, it received a very rapid addition to its bulk. At this time, it measured nearly six inches in diameter, seemed to be confined by a firm and dense covering, and the morbid parts had an obscure fluctuation. From the first to the last, the tumour had been productive of very little pain.

"Judging from the apparent fluctuation, that the tumour was encysted, it was resolved, at a consultation, to puncture the swelling, draw off its contents, and then pass a seton through it. By plunging a lancet into it, only a very small quantity of blood, partly coagulated, and partly fluid, was discharged; a quantity so trifling, that, after its evacuation, the size of the tumour was not perceptibly reduced. A seton was passed through the swelling. At this time the man was in perfect health.

"About ten hours after the operation, the patient was seized with extremely violent rigors, followed by heat, thirst, pain in the back, excessive pain in the tumour, and oppressive sickness.

"An emetic was prescribed; but, instead of producing vomiting, it operated as a cathartic. To remove the irritation, the seton was withdrawn. The pain in the tumour, however, and the general uneasiness continued to increase, and thirty hours subsequent to making the puncture, air began to issue from the track of the seton; and afterwards the cellular membrane of the neck, and of the other parts of the body in succession, became distended with a gaseous fluid. In the course of a few hours, after the commencement of the general emphysema, the man died.

"Twelve hours after death, when the body was free from putrefaction, it was inspected. The emphysema was neither increased nor diminished since death; and some idea may be formed of its extent, when the scrotum was distended to the size of the head of an adult. Even the cavities of the heart, and the canals of the blood-vessels, contained a considerable quantity of air. We could discover no direct communication between the tumour and the trachea or lungs, although such was carefully sought for." (*A. Burns on the Surgical Anatomy of the Head and Neck*, p. 51—53.)

From such cases, we may infer, that from the mere rupture of a few of the bronchial cells, occasioned by irregular action of the lungs, or by some other internal cause, a spontaneous diffusion of air may take place in the cellular tissue. Such examples are dependent on the same cause as emphysema from injury of the lungs; only the rupture of the bronchial cells in the former cases is less obvious.

Emphysema frequently attends gangrene, especially the humid. Here, however, the air is the product of putrefaction, and the disorder has not the smallest connection with any injury, or disease, of the lungs. In one instance of gangrene from an external cause, Dr. Hunter found, that he could as easily mark the progress of the mortification from day to day by the emphysema, as by the change of colour in the integuments. (See *Med. Obs. and Inq.* vol. ii.) Gangrene, when accompanied by emphysema, is observed to have a great disposition to spread. (*See James on Inflammation*, p. 96.)

A remarkable case is recorded by Dr. Duncan, in which several emphysematous tumours were formed in succession over the chest and neck, in consequence of communications formed by ulceration between the lung and common cellular tissue. (See *Edinb. Med. Chir. Trans.* vol. i.) Or the air may first get into the cavity of the pleura, so as to occasion pneumo-thorax, and afterwards pass into the cellular tissue through an ulceration of the pleura costalis. (See *Halliday, Op.* cit.) emphysema has been known to arise from the passage of air from the alimentary canal, through a rupture of its parietes. (*Haller, Opuscula Pathol. Obs.* 31. t. iii.) A violent contusion of the abdomen has produced in this way an extensive emphysema. (See *Archive's Gén. de Med.*) In ruminating animals, in consequence of the fermentation of their food, the accident is not uncommon. (See *Obs. sur les Animaux Domestiques, par MM. Chabert et Huzard.*)

C. C. Puysch, De Emphysemate, Haller, Disp. Chir. ii. 567. Halæ, 1733. *H. A. Nies*, De Miro Emphysemate, 4to. Duisb. ad Rhen. 1751. *Hewson*'s Paper in Medical Obs. and Inquiries, vol. iii. Mém. de l'Acad. Royale des Sciences, for 1713. Dr. *W. Hunter*, in Med. Obs. and Inquiries, vol. ii. *Cheston*, in Pathological Inquiries. *Abernethy*'s Surgical Works, vol. ii. *Richter*, von der Windgeschwulst, in Anfangsgr. der Wundarzneykunst, b. 1. p. 451, &c. *John Bell*, On Wounds, edit. 3. Edin. 1812. *Halliday* on Emphysema, 1807. *Allan Burns*, On the Surgical Anatomy of the Head and Neck, p. 52. &c. Trans. of a Society for the Improvement of Medical and Chir. Knowledge, vol. i. p. 262. *Wilmer*'s Observations in Surgery, p. 143. *F. C. Waitz*, De Emphysemate, 4to. Lips. 1803. *Lassus*, Pathologie Chir. t. ii. p. 321, &c. édit. 1809. Dict. des Sciences Méd. t. xii. p. 1, &c. Dict. de Med. et de Chir. Pratiques, art. Emphyseme. *Townsend*, in Cyclopædia of Pract. Med. art. Emphysema. *J. Hennen*, Principles of Military Surgery, p. 376. edit. 2. 8vo. Edin. 1820. *C. Bell*, Surgical Obs. vol. i. p. 161. &c. *Laennec*, On Dis. of the Chest, ed. by Forbes, ed. 3. *Dupuytren*, Clinique Chir. t. i. p. 110. 8vo. Paris, 1832.

EMPLASTRUM AMMONIACI CUM ACETO. ℞. Ammoniaci purif. ℥ ij. Acidi Acetici, ℥ iij. Ammoniacum in aceto liquefactum evapora in vase ferreo ad emplastri crassitudinem.

EMPLASTRUM AMMONIACI SCILLITICUM. ℞. Gumm. ammoniaci, ℥ j. Aceti Scillitici, q. s. ut fiant emplastrum, quo pars affecta tegatur. Mr. Ford found this plaster useful in some scrofulous affections. It may be rendered more stimulating by sprinkling it with squills. (*Ford on the Hip-joint*, p. 59.) It was recommended by Swediaur; *London Medical Journal*, vol. i. p. 198.

EMPLASTRUM AMMONIACI CUM HYDRARGYRO. Discutient.

EMPLASTRUM AMMONIACI CUM CICUTA. ℞. Gum. ammon. ℥ iij. Extracti Conii, ʒij. Liq. Plumb. acet. ʒj.

Dissolve the ammoniacum in a little vinegar of squills, then add the other ingredients, and boil them all slowly to the consistence of a plaster. Discutient.

EMPLASTRUM AMMONIÆ. ℞. Sapon. ʒij. Emplastr. Plumbi. ʒss. Ammon. mur. ʒj.

The two first articles are to be melted together, and when nearly cold, the muriated ammonia, finely powdered, is to be added. This plaster stimulates the skin, excites the action of the absorbents, and disperses many chronic swellings and indurations.

EMPLASTRUM CANTHARIDIS. (See *Blister.*)

EMPLASTRUM GALBANI COMPOSITUM. Properties discutient.

EMPLASTRUM HYDRARGYRI. L. P. Properties discutient.

EMPLASTRUM PLUMBI. L. P. The common adhesive, or sticking plaster.

EMPLASTRUM SAPONIS. The plaster commonly applied to fractures, bruised parts, and various indurations of a chronic nature.

EMPYEMA (from ἐν, within, and πύον, pus, or matter). A collection of purulent matter in the cavity of the chest.

The ancients made use of the word, "empyema," to express every kind of internal suppuration. It was Ætius, who first restricted the term to collections of matter in the cavity of the pleura, or membrane lining the chest; and all the best modern surgeons invariably attach this meaning alone to the expression.

The operation for empyema properly means the making of an opening into the thorax, for the purpose of discharging matter collected in the cavity of the pleura, though the phrase with several writers denotes making an incision into the chest, in order to let out any effused, or confined fluid, whether matter, blood, or a serous fluid. It is not always easy, however, to determine, *à priori*, the precise nature of the fluid, collected in the chest. Thus, in a case of empyema of two months' standing, occasioned by the bursting of a tubercular abscess of the lung into the pleura, the fluid was observed by Dr. Townsend to present all the characters of genuine pus; while, in another case, where the effusion was produced by a similar cause, and assumed the same chronic form, paracentesis gave issue to a fluid as transparent and colourless as water. (See *Cyclop. of Pract. Med.* art. *Empyema.*)

Acute and chronic abscesses not unfrequently form in the cellular tissue between the pleura and the ribs and intercostal muscles. A swelling occurs between two of those bones; the skin does not undergo any change of colour; a fluctuation is distinguishable, and sometimes extensive œdema.

With respect to abscesses, formed in the cellular tissue, connecting the pleura costalis to the intercostal muscles, they rarely burst into the chest, the pleura being considerably thickened. However, in order to keep them from spreading extensively, as well as to obviate any possibility of their breaking inwards, the best rule is to make an early, and, if possible, a depending opening. The motions of respiration then both promote the exit of the matter, as well as the contraction of the cavity, in which it was lodged; and the disease, if unattended with caries, generally terminates favourably.

It often happens, however, that the ribs are carious, and then the cure is more tedious and difficult. A modern writer, indeed, informs us that, when the inside of the rib is extensively carious, or when the caries is near the junction of the bone to the spine, the fistula is incurable. (*Lassus, Pathologie Chir.* t. i. p. 128. édit. 1809.) On the other hand, another surgeon of vast experience recommends us to endeavour to separate the diseased bone, either by cutting it away or employing the trepan. (*Pelletan, Clinique Chir.* t. iii. p. 253.) Were a part of a diseased rib to admit of being sawn away, Mr. Hey's convex saw would be a more proper instrument for the purpose than a trepan.

An abscess of the preceding kind may be so situated, and attended with such a pulsation, as greatly to resemble an aneurism of the origin of the aorta. An interesting case of this description is detailed by Pelletan (*Clinique Chir.* t. iii. p. 254.), and another was seen by Boyer. (*Mal. Chir.* t. vii. p. 333.)

When the surface of the lungs, and that of the pleura costalis have become adherent to each other, in the situation of the abscess, so as to constitute what is termed *encysted empyema*, the pus, disposed by a law of nature to make its way to the surface of the body, generally occasions ulceration of the intercostal muscles, and collects on the outside of them. An abscess of this kind comes on with a deep-seated pain in the part affected; an œdematous swelling, which retains the impression of the finger; and a fluctuation, which is at first not very distinct, but, from day to day, becomes more and more palpable, and, at length, leads the surgeon to make an opening.

If this be not done when the fluctuation becomes perceptible, the abcess may possibly insinuate itself into the cavity of the pleura, in consequence of the adhesion being in part destroyed by ulceration. Sabatier affirms, that the case may take this course, even when the abscess has been punctured, and while a free external opening exists; and this experienced surgeon has adduced a fact in confirmation of such an occurrence. (See *Méd. Opératoire*, tom. ii. p. 249.)

In a few instances, the surface of the lung ulcerates, and the matter is voided from the trachea. But, in the majority of examples, the pus makes its way outwards through the pleura costalis. If inflammation occurs in the anterior mediastinum, and ends in suppuration, the abscess may possibly burst into neither of the cavities of the chest, but make its way outwards, after rendering the sternum carious, as happened in the example recorded by Van Swieten. (*Comment on Boerhaave's 895th Aphorism.*)

But though, collections of matter in the anterior mediastinum are influenced by the general law, whereby abscesses in general tend to the surface of the body, and though it be true, that they rarely burst into the cavity of the pleura, the contrary may happen, as is proved by the 9th case in La Martinières's memoir on the operation of trepanning the sternum. Here the event was the more unexpected, as there was already an external opening in the abscess.

External injuries, such as the perforation of the sternum with a sword (*Vanderwiel, Obs.* 29., *Cent.* 1.), a contusion, a fracture, or a caries of this bone, may give rise to an abscess in the anterior mediastinum. Galen has recorded a memorable example, where the abscess was the consequence of a wound of the fore part of the chest. After the injury, which was in the region of the sternum, seemed quite well, an abscess formed in the same situation, and being opened, healed up. The part, however, soon inflamed, and suppurated again. The abscess could not now be cured. A consultation was held, at which Galen attended. As the sternum was obviously carious, and the pulsation of the heart was visible, every one was afraid of undertaking the treatment of the case, since it was conceived, that it would be necessary to open the thorax itself. Galen, however, engaged to manage the treatment without making any such opening, and he expressed his opinion that he should be able to effect a cure. After the removal of a portion of the bone, the heart was quite exposed (as is alleged), by reason of the pericardium having been destroyed by the previous disease. The patient experienced a speedy recovery.

J. L. Petit met with an abscess in the anterior mediastinum, in consequence of a gun-shot wound in the situation of the sternum. The injury had been merely dressed with some digestive application; no dilatation, nor any particular examination of the wound had been made. The patient, after being to all appearance quite well, and joining his regiment again, was soon taken ill with irregular shiverings, and other febrile symptoms. Petit probed the wound, and found the bone affected. As there was a difficulty of breathing, he suspected an abscess either in the diploe, or behind the sternum, and, consequently, he proposed laying the bone bare, and applying a trepan. The operation afforded an outlet for some sanious matter, and, as soon as the inner part of the sternum had been perforated, a quantity of pus was discharged. The patient was relieved, and afterwards recovered. (*Petit, Mal. Chir.* t. i. p. 80.)

Another instance, in which an abscess behind the sternum was cured by making a perforation in that bone opposite the lower part of the cavity, in which the matter collected, is recorded by De la Martinière. (*Mém. de l'Acad. de Chir.* t. xii. édit. 12mo.)

When, in consequence of inflammation, an abscess forms deeply in the substance of the lungs, the pus more easily makes its way into the air-cells, and tends towards the bronchi, than towards the surface of the lungs. In this case, the patient spits up purulent matter. When the opening, by which the abscess has burst internally, is large, and the pus escapes from it in considerable quantity at a time, the patient is in some danger of being suffocated. However, if the opening be not immoderately large, and the pus, which is effused, be not too copious, a recovery may ensue. Abscesses in the substance of the diaphragm, and collections of matter in the liver, may also be discharged by the pus being coughed up from the trachea, when the parts affected become connected with the lungs by adhesions, and the abscesses of the liver are situated on its convex surface. When the collection of matter in the liver occupies any other situation, the abscess frequently makes its way into the colon, and the pus is discharged with the stools. Several cases of this kind are related by authors: Sabatier has recorded two (*Méd. Opératoire*); Le Dran makes mention of others; and Pemberton (*Diseases of the Abdominal Viscera*, p. 36.) relates additional instances of a similar nature.

I shall now proceed to the consideration of empyema strictly so called. Sometimes it is a consequence of a penetrating wound of the chest; occasionally it proceeds from the bursting of one or more vomicæ; in a few examples, it arises from the particular way in which abscesses of the liver burst (*Journ. de Méd.* t. iii. p. 47. *Morgagni*, epist. xxx. art. 4.); but, in the greater number of instances, originates from pleuritic inflammation, either acute or chronic. (*Boyer, Mal. Chir.* t. vii. p. 352.) Empyema more rarely takes place in both than in one cavity of the pleura.

Sometimes firm adhesions intersect the purulent effusion, and divide the sac of the pleura into distinct compartments. Dr. Townsend examined the body of a patient, who died of empyema in the Whitworth Hospital, and in whom the effusion was contained in three compartments, so perfectly distinct from each other, that, if paracentesis had been performed, only one of the three separate collections would have been discharged. (See *Cyclop. of Pract. Medicine*, art. *Empyema.*) In all cases, the purulent, or thinner fluid of empyema may be said to be principally, if not entirely, a morbid secretion from the pleura; and even where pus, or other matter is introduced from another source, as from the rupture of a pulmonary, or hepatic abscess, the collection of fluid, which constitutes the empyema consequent thereon, does not consist so much of the matter of the abscess, as of the morbid secretion from the pleura, which the irritation caused by the presence of that matter, produces. (*Townsend, ib.*)

In cases of empyema, the pleura is almost constantly lined by a coating of adventitious matter, which gives the interior of the chest much more the appearance of the walls of a large abscess, than of a cavity lined by a serous membrane. The adventitious membrane is susceptible of inflammation, ulceration, and gangrene, and when the latter change occurs, the detachment of the slough may form an outlet for the empyema. The adventitious membrane of serous tissues is also capable of transformation into fibrous, cartilaginous, or osseous tissues, and is liable to the developement of tubercles in it. These are generally small and numerous, and mostly follow chronic pleuritis. Sometimes, however, they form numerously and rapidly. (See *Andral, Clinique Méd.* t. ii.)

When empyema arises from thoracic inflammation, pleuritis, or pneumonia, the symptoms characterising it, are always preceded by those of the disease, of which the effusion of pus upon the diaphragm is the effect. Inquiry must, therefore, be made whether the patient has pleurisy, or peripneumony, the symptoms of which have lasted longer than a fortnight; and whether, after a transient amendment, there have been frequent shiverings, followed by a low continued fever, with nightly exacerbations. Now these first circumstances justify the belief, that the inflammatory disorder has terminated in suppuration, and that the symptoms afterwards experienced depend upon effusion of matter in the chest. Some of these arise from the mechanical action of the pus upon the lungs, heart, and parietes of the chest, and belong also to other effusions in the thorax; the rest may be said to be the effects of ulceration and suppuration of the parts on the animal economy, and, therefore, particularly belong to empyema.

First, of the common symptoms, respiration is difficult, short, and frequent; the patient suffers great oppression, and experiences a sense of suffocation, and of weight upon the diaphragm. He cannot move about, even for a short time, without being quite out of breath, and threatened with syncope. He has an almost incessant, and very fatiguing cough, which is sometimes dry, sometimes attended with expectoration. (*Boyer, Mal. Chir.* t. vii. p. 356.)

Few writers of the last century have described the symptoms of empyema with more discrimination and accuracy than Mr. Samuel Sharp. He remarks, that it has been almost universally taught, that, when a fluid is extravasated in the thorax, the patient can only lie on the diseased side, the weight of the incumbent fluid on the mediastinum becoming troublesome, if he places himself on the sound side. For the same reason, when there is fluid in both cavities of the thorax, the patient finds it most easy to lie on his back, or to lean forwards, in order that the fluid may neither press upon the mediastinum, nor the diaphragm. But, it is noticed by Mr. Sharp, that, however true this doctrine may prove in most instances, there are a few, in which, notwithstanding the extravasation, the patient does not complain of more inconvenience in one posture than another, nor even of any great difficulty of breathing. (See *Le Dran's Obs.* 217., and *Marchetti*, 65.)

On this account, observes Mr. Sharp, it is sometimes less easy to determine when the operation is requisite, than if we had so exact a criterion, as we are generally supposed to have. But, says he, though this may be wanting, there are some other circumstances, which will generally guide us with a reasonable certainty. He states, that the most infallible symptom of a large quantity of fluid in one of the cavities of the thorax, is a preternatural expansion of that side of the chest, where it lies; for, in proportion as the fluid accumulates, it will necessarily elevate the ribs on that side, and prevent them from contracting so much in expiration as the ribs on the other side. This change is said to be most evident, when the surgeon views the back of the chest. (*Boyer*, vol. cit. p. 357.) Mr. Sharp also refers to *Le Dran's Obs.* 211. vol. i. in order to prove, that the pressure of the fluid on the lungs may sometimes be so great, as to make them collapse, and almost totally obstruct their function. When, therefore, says Mr. Sharp, the thorax becomes thus expanded, after a previous pulmonary disorder, and the case is attended with the symptoms of suppuration, it is probably owing to a collection of matter. The patient, he observes, will also labour under a continual low fever, and a particular anxiety from the load of fluid.

Besides this dilatation of the cavity by an accumulation of the fluid, the patient will be sensible of an undulation, which is sometimes so evident that a bystander can plainly hear it in certain motions of the body. Mr. Sharp adds, that this was the case with a patient of his own, on whom he performed the operation; but, the fluid, in this instance, he says, was very thin, being a serous liquid, rather than pus. Sometimes, when the practitioner applies his ear close to the patient's chest, while this is agitated, a noise can be heard, like that produced by shaking a small cask, not quite full of water. (See *Dr. Archer's Case, in Trans. of the Fellows, &c. of the King's and Queen's College of Physicians in Ireland*, vol. ii. p. 2.) In this instance, the fluid resembled whey.

According to the same author, it will also frequently happen, that though the skin and intercostal muscles are not inflamed, they will become œdematous in certain parts of the thorax; or, if they are not œdematous, they will be a little thickened; or, as Boyer states, the intercostal spaces are widened, and, when the empyema is considerable, instead of being depressed, as they are in thin persons, they project beyond the level of the ribs. (*Mal. Chir.* t. vii. p. 357.) These symptoms, joined with the enlargement of the thorax, and the preceding affection of the pleura or lungs, seem unquestionably to indicate the propriety of the operation. But, observes Mr.

Sharp, amongst other motives to recommend it upon such an emergency, this is one, that if the operator should mistake the case, an incision of the intercostal muscles would neither be very painful, nor dangerous. (See *Critical Inquiry into the present State of Surgery*, sect. on Empyema.)

"The difficulty of lying on the side, opposite to the collection of pus," says Le Dran, "is always accounted a sign of an empyema. This sign, indeed, is in the affirmative; but, the want of it does not prove the negative; because, when there is adhesion of the lungs to the mediastinum, the patient may lie equally on both sides." (*Le Dran's Obs.* p. 108. edit. 2.) The explanation of this circumstance, offered by Le Dran, is, that when the cyst, in which the matter is contained, is between the mediastinum and the lungs, the mediastinum gradually yields to the volume of the pus, in proportion as it is formed, and the cyst in which it is contained becomes dilated; "whence habitude becomes a second nature." Whereas, in an empyemal person, in whom the lung is not adherent to the mediastinum, and who lies on the side opposite to that on which the collection of pus is situated, the mediastinum is on a sudden loaded with an unusual weight of fluid. (P. 111.)

Richerand contends, that the difficulty of breathing, which patients with extravasated fluid in the chest, experience in lying upon the side, opposite to that on which the disease is situated, never originates, as has been commonly taught and believed, from the fluid pressing upon the mediastinum and opposite lung. "I have (says he) produced artificial cases of hydrothorax, by injecting water into the thorax of several dead subjects, through a wound made in the side. This experiment can only be made on subjects, in which the lungs are not adherent to the parietes of the chest. In this way, from three to four pints of water were introduced. I then cautiously opened the opposite side of the chest: the ribs and lungs being removed, the mediastinum could be distinctly seen, reaching from the vertebræ to the sternum, and supporting, without yielding, the weight of the liquid, in whatever position the body was placed.

"It is evident then, that patients, with thoracic extravasations, lie on the diseased side, in order not to obstruct the dilatation of the sound side of the respiratory organs, one part of which is already in a state of inaction. It is for the same reason, and in order not to increase the pain by the tension of the inflamed pleura, that pleuritic patients lie on the diseased side. The same thing is observable in peripneumony: in a word, in all affections of the parietes of the chest." (*Nosogr. Chir.* t. iv. p. 168, 169. édit. 2.)

There may be some truth in the foregoing statement; but the experiments are far from being conclusive, with respect to the assertion, that, in empyema, hydrothorax, &c. the fluid on one side of the chest does not compress the opposite lung. In the first place, the quantity of fluid is frequently much larger, than that which Richerand injected. Secondly, although the mediastinum may not be apt to yield at once to the weight of a liquid suddenly injected into one side of the thorax; yet, it may do so by the gradual effect of disease. Thirdly, many of the phenomena of empyema seem adverse to Richerand's inference.

In opposition to Richerand's view, Dr. Townsend argues, that we have direct proof of the influence of the weight of the fluid; for, in pneumothorax with empyema, the patient can generally lie on the sound side, so long as the effusion is principally gaseous; but, as the proportion of ponderable fluid increases, decumbiture on the sound side becomes impossible. In like manner, in cases of empyema, the dyspnœa is generally greatly aggravated by this posture; but, when the fluid has been discharged, the patient is immediately able to lie on the sound side, though the necessity for its free dilatation continues as great as ever, the diseased side being still in a state of inaction. Thus, in a case of empyema, with pneumo-thorax, where paracentesis was performed, the patient could lie on the sound side on the night after the fluid was drawn off, though it was ascertained by auscultation, that the side was then filled with air. (See *Dublin Hospital Reports*, vol. v.; and *Townsend* in *Cyclopædia* of *Practical Medicine*, art. *Empyema.*)

When empyema is double, the patient can seldom lie in the horizontal position; but remains seated, and with the trunk inclined forward.

Although surgeons should be aware, that patients with empyema can sometimes lie in any position, without particular aggravation of the difficulty of breathing, yet, it ought to be distinctly understood, that the generality of patients cannot place themselves on the side opposite to that, on which the collection of pus is situated, without their respiration being very materially obstructed. Another circumstance, also, which deserves to be mentioned while we are treating of the symptoms of empyema, is, that the œdema of the integuments is sometimes not confined to the thorax, but extends to more remote parts, on the same side of the body as the collection of matter. Both the foregoing remarks are confirmed by an interesting case, published by Mr. Hey.

Sept. 3. 1788, Mr. Hey was desired to visit John Wilkinson, who had been ill ten days of the influenza. The patient was found labouring under a fever, attended with cough, difficulty of breathing, and pain in the left side of the thorax. He was bled once; blisters were repeatedly applied to the chest; and he took nitre and antimonials, with a smooth linctus to allay his cough. "He was repeatedly relieved by these means, especially by the application of the blisters; but repeatedly relapsed. At last, he became so ill, that he breathed with the utmost difficulty, and could not lie on the right side, without danger of immediate suffocation."

Mr. Hey found the patient in the state just now described on the 17th. of September. "His face and especially his eyelids were a little swollen on the left side." The left side of the thorax was larger than the right, and its integuments were œdematous. Upon pressing the intercostal muscles, they felt distended; they yielded a little to a strong pressure, but rebounded again. The abdomen, especially at its upper part, appeared to be fuller than in the natural state. (See *Hey's Practical Obs. in Surgery*, p. 476.) This last symptom is also particularly noticed by Boyer. (*Mal. Chir.* t. vii. p. 357.)

Another remarkable symptom, which is occasionally produced by collections of matter in the chest, is an alteration in the position of the heart.

I have seen a patient in St. Bartholomew's hospital, who had so large a quantity of matter in the left bag of the pleura, that it completely displaced the heart, which pulsated against the inside of the chest, at a considerable distance to the right of the sternum. This man's life might perhaps have been saved, had paracentesis thoracis been performed in time. Some suspected an aneurism from the throbbing on the right of the sternum: and the case was not fully understood till after death, when the body was opened. A little attention to the symptoms, however, might have convinced any man of moderate understanding, that it was an empyema, and that making an opening, for the discharge of the matter, afforded the only rational chance of preserving life. There had been pain and inflammation in the chest, followed by shiverings; there was very great difficulty of breathing; the heart, which previously used to beat in the usual place, no longer did so; but now pulsated on the right side of the thorax.

That the heart should be displaced in this manner by any large collection of fluid in the right cavity of the thorax, one would naturally expect. Baron Larrey has related a highly interesting case, where the heart was not only pushed considerably to the right of the sternum, but its action was so much impeded by the derangement of its position, that the pulse in the large arteries was thereby rendered extremely feeble. In this instance, also, the diaphragm had descended so low down, as to force some of the small intestines into the cavity of the pelvis. (*Mém. de Chir. Militaire*, t. iii. p. 447., &c.) Pelletan has recorded an example, in which a collection of fluid in the left cavity of the chest displaced the heart, the pulsations of which were perceptible betwixt the third and fourth ribs of the right side, near the sternum. (*Clinique Chir.* t. iii. p. 276.) Boyer speaks of one case, in which the displacement of the heart was so extensive, that its pulsations were felt near the right axilla. (*Traité des Mal. Chir.* t. vii. p. 357.) In the anatomical collection at Strasburg, is a preparation exhibiting the displacement of the heart into the right side of the chest, by matter in the left pleura, the left lung being nearly annihilated. (*Lobstein, Compte de son Museum Anat.* p. 39. 8vo. 1820.) When empyema is on the right side, the change in the heart's position is not in general so remarkable; yet, with the stethoscope, it will generally be found to pulsate considerably to the left of its natural situation. In two cases, referred to by Dr. Townsend, the pulsation was distinctly felt in the axilla between the fourth and fifth ribs. (*Cyclopædia of Pract. Med.* art. *Empyema.*) The heart is sometimes thrust downward by collections of fluid in the chest, and its pulsation is distinguishable in the epigastrium. (*Hodgson on the Diseases of Arteries and Veins*, p. 95.) In cases of extensive empyema, even the liver has been pressed down into the right iliac fossa (*Stoll, Ratio Medendi*). The descent of the diaphragm, by thrusting the abdominal viscera before it, may cause an appearance as if the liver were enlarged. Of this, an instance is recorded by M. Roux, the true nature of which was detected by Bichat, who cured the patient by paracentesis. (*Œuvr. Chir. de Desault*, t. iii.)

When the cavity of the pleura contains fluid, and the surgeon strikes the thorax repeatedly, with the ends of his fingers, a dull sound is produced, quite different from what would occur, were the chest in its natural state. Besides this dulness of sound on percussion, the respiratory murmur is absent on the diseased side, which remains perfectly motionless. In the opposite lung, puerile respiration is distinguishable, accompanied with violent action of the respiratory muscles.

The symptoms of empyema are frequently equivocal. Panarolius opened a man, whose left lung was destroyed, at the same time that the thorax contained a considerable quantity of pus. Although the patient had been ill for two months, he had suffered no difficulty of breathing, and had had only a slight cough. Le Dran met with a case of nearly the same kind. A patient, who had been for three days affected with a considerable oppression, and an acute pain on the left side of the chest, got somewhat better. He felt no material difficulty of breathing, on whatever side he lay. The only thing, which he complained of, was the sense of a fluctuation in his thorax, and a little obstruction of his respiration, when he was in a sitting posture. These symptoms did not seem sufficiently decided to justify the operation, and it was delayed. The febrile symptoms continued, with cold sweats, and the patient died on the eighth day. Five pints of pus were found collected in the chest. (See *Le Dran's Obs. in Surgery*, p. 109, 110. edit. 2.)

The symptoms more particularly depending upon empyema itself, that is to say, upon disease and suppuration within the chest, are nearly the same as those, which accompany all large deep-seated abscesses. The fever, attending the thoracic inflammation, which ends in suppuration, gradually diminishes, but does not entirely cease. On the contrary, it soon changes into hectic, attended with flushings of the cheeks, heat of the palm of the hands, and exacerbations every evening, and after meals. In the night, the upper parts of the body are covered with perspiration; the patient is tormented with insatiable thirst: his appetite fails; his debility becomes extreme; he is subject to frequent fainting fits; diarrhœa ensues; and the finger nails become curved, shining, and of the yellow tinge observable all over the body. At length, the utmost emaciation, and the facies Hippocratica, come on, frequently attended with dilated pupils, and enfeebled vision, and indicating the approach of death.

As the operation of empyema, and some other particulars, relating to this subject, are treated of in another part of this Dictionary (see Paracentesis of the Thorax), it will only be necessary for me here to subjoin a list of works, which may be advantageously consulted for information on empyema.

A. Vater et *J. E. Mutillet*, Empyema, e vomica pulmonis, rupta in cavitatem pectoris dextram effusa, indeque pulmo hujus lateris compressus penitusque ab officio remotus, Wittemb. 1731. (*Haller*, Disp. ad Morb, 2. 4031.) *Sharp*'s Critical Enquiry into the Present State of Surgery, sect. on Empyema. *Le Dran*'s Obs. in Surgery. *J. L. Petit*, Maladies Chirurgicales, t. i. chap. iii. *Warner*'s Cases in Surgery, chap. vi. edit. 4. Mém. sur l'Operation du Trèpan au Sternum, par M. de la Martinière, in Mém. de l'Acad. Royale de Chirurgie, t. xii. p. 342. edit. 12mo. *L. G. Van Melcote*, De Empyemate, Teneramund. 1783. *Sabatier*, Médecine Operatoire, t. ii. p. 247, &c. édit. 1. *Andouard*, De l'Empyeme, Cure Radicale obtenue par l'Operation, &c. 8vo. Paris, 1808. *Flajani*, Collezione d'Osservazioni, &c. di Chirurgia, t. iii. p. 185, &c. 8vo. Roma, 1802. *Richerand*, Nosogr. Chir. t. iv. sect. des Maladies de l'Apparel respiratoire. *Hey*'s Practical Obs. in Surgery, ed. 3. *Lassus*, Pathologie

Chir. t. i. p. 122. &c. *Larrey*, Mém. de Chirurgie Militaire, t. iii. p. 442. ; et t. iv. p. 356. &c. *Pelletan*, Clinique Chir. t. iii. p. 236. &c. *J. Hennen*, Principles of Military Surgery, p. 384, &c. ed. 2. 8vo. Edinb. 1820. *Boyer*, Mal. Chir. t. vii. p. 351, &c. 8vo. Paris, 1821. *Andral*, Précis d'Antomie Pathol. Also, Clinique Méd. t. ii. Archer, in Trans. of Dublin Association, &c. vol. ii. *Laennec*, on Diseases of the Chest, ed. by *Forbes. Duncan*, in Ed. Med. Chir. Trans. vol. i. *Graves* and *Stokes*, in Dublin Hospital Reports, vol. v. Edinb. Med. Journ. No. 93. *Townsend*, art. Empyema, in Encyclopædia of Practical Medicine, part. 7.

ENCANTHIS (from ἐν, and *κάνθος*, the angle of the eye), at its commencement, is a small, soft, red, and sometimes rather livid, excrescence, which grows from the caruncula lachrymalis, and, at the same time, from the neighbouring semi-lunar fold of the conjunctiva. The inveterate encanthis is ordinarily of considerable magnitude; its roots extend beyond the caruncula lachrymalis, and semilunar fold, to the membranous lining of one or both eyelids. The patient experiences very serious inconvenience from its interposition between the commissure of the eyelids, which it necessarily keeps asunder. Thus, indeed, it keeps up a chronic ophthalmy, impedes the action of the eyelids, and, in particular, prevents the complete closure of the eye. Besides, partly by compressing, and partly by displacing the orifices of the puncta lachrymalia, it obstructs the free passage of the tears into the nose.

According to Scarpa, this excrescence, on its first appearance, is commonly granulated, like a mulberry, or is of a ragged and fringed structure. Afterwards, when it has acquired a certain size, one part of it represents a granulated tumour, while the rest appears like a smooth, whitish, or ash-coloured substance, streaked with varicose vessels, sometimes advancing as far over the conjunctiva, covering the side of the eye next to the nose, as where the cornea and sclerotica unite. In this advanced state, the encanthis constantly interests the caruncula lachrymalis, the valvula semilunaris, and the membranous lining of one, or both eyelids. In addition to the roots, which in such circumstances connect the excrescence with the caruncula lachrymalis, the semilunar fold, and the conjunctiva of the globe of the eye, the encanthis emits an appendage, or prominent firm elongation, along the inside of the upper, or lower eyelid, in the direction of its edge. The middle, or body, of the encanthis divides near the cornea, as it were, like a swallow's tail, to form two appendages, or elongations, one of which extends along the inner surface of the upper eyelid by the margin of which it is covered, while the other shoots, in a direction from the internal towards the external angle, along the inside of the lower eyelid, which also conceals it beneath its edge.

The body of the encanthis, or that middle portion of the whole excrescence, which reaches from the caruncula lachrymalis, and semilunar fold, inclusively, over the conjunctiva almost to the junction of the sclerotica with the cornea, sometimes forms a prominence, as large as a small nut or chestnut. At other times, it is of considerable size, but depressed, and broken down, as it were, at its centre. Still, however, the body of the encanthis preserves that granulated appearance, which prevailed at first; while one, or both the appendages, on the inside of the eyelids, appear rather like a fleshy than a granulated substance.

Sometimes, the encanthis assumes a cancerous malignancy, evinced by the dull red, leaden, or (as Beer says) the bluish-red colour of the excrescence; by its excessive hardness, and the lancinating pains, which occur in it, and extend to the forehead, the whole eye-ball, and the temple, especially, when the tumour has been slightly touched; by the propensity of the excrescence to bleed; and by the partial ulcerations on its surface, which emit a fungous substance, and a thin, and exceedingly acrid discharge. The disease is constantly attended with epiphora, and preceded by a scirrhous induration of the caruncle. The eyeball, and neighbouring bones, which are of a spongy texture, soon participate in the disease, and the lower eyelid becomes everted. (*Beer, Lehre von den Augenkr*. b. ii. p. 187., 188.) This form of encanthis only admits of palliative treatment; unless, indeed, an effort be made to extirpate it entirely, together with the whole of what is contained in the orbit, and, even then, the event is dubious.

Beer joins Scarpa in the statement that the operation rarely proves successful, and adds, that it is always followed by an incurable weeping, and a considerable eversion of the lower eyelid. (Vol. cit. p. 189.) Fortunately, the truly cancerous encanthis is uncommon; Mr. Guthrie has not seen it; (*Operative Surgery of the Eye*, p. 117.) and Mr. Travers, who was surgeon to the London Eye Infirmary several years, never met with an instance of it. (*Synopsis of Diseases of the Eye*, p. 103.)

The benign encanthis, how large soever it may be, is always curable by extirpation. Those instances, which are small, incipient, and granulated, like a mulberry, or of a fringed structure, which originate either from the caruncula lachrymalis, or the semilunar fold of the conjunctiva, or from both these parts together, and even in part from the internal commissure of the eyelids, may be raised by means of a pair of hook forceps, and cut off from the whole of their origin, closely to their base, with the curved scissors with convex edges. In cutting out an encanthis of small size, care should be taken not to remove, together with that portion of the excrescence which originates from the caruncula lachrymalis, any more of this latter body, than what is absolutely necessary for the precise eradication of the disease, in order that no irremediable weeping may be occasioned.

When the little excrescence has been detached from all its roots, says Scarpa, the eye must be washed several times with cold water, in order to cleanse it from the blood, and then it is to be covered with a piece of fine linen, and a retentive bandage. On the 5th, 6th, or 7th day, the inflammation arising from the operation entirely ceases, and the suppuration from the wound is accompanied with the mucous appearance already described. The little wounds are then to be touched with a piece of alum, scraped to a point like a crayon, and the zinc collyrium is to be injected into the affected eye several times a day. If these means should not bring about the wished-for cicatrisation, but, on the contrary, the small wounds situated on the caruncula, and internal commissure of the eyelids, should become stationary, and covered with proud flesh, the argentum nitratum ought to be applied to them.

Excision is equally applicable to the inveterate encanthis, which is of considerable size, and broken down at its body, or which forms a prominence, as large as a nut, or chestnut, with two fleshy appendages extending along the inner surface of one or both eyelids. The application of a ligature to such an excrescence ought never to be regarded as a method of cure; for the large, inveterate encanthis never has a sufficiently narrow neck to admit of being tied. On the contrary, when the tumour is voluminous, its roots, invariably, extend to the caruncula lachrymalis, the semilunar fold, and the conjunctiva covering the eyeball, oftentimes nearly as far as the cornea. In this state, also, the encanthis has one or two fleshy appendages, which reach along the membranous lining of one or both eyelids. Hence, though the ligature were to produce a separation of the body of the encanthis, one or both the appendages would still remain to be extirpated. The second operation could only be accomplished with the knife. In this disease, there is no foundation for the fear of hemorrhage, to which the advocates for the ligature attach so much importance; for, cases are recorded of considerable, inveterate encanthes being removed, without the least untoward occurrence from loss of blood. To these, Scarpa observes, he could add a great number of his own, so that no doubt can now be entertained on this point.

When the encanthis is large, and inveterate, with two extensive fleshy elongations, one on the inside of the upper eyelid, and the other on that of the lower one, we are to proceed in the following manner. The patient being seated, an assistant is to turn out the inside of the upper eyelid, so as to make one of the appendages of the encanthis project outward. By means of a small bistoury, a deep incision is next to be made into the elongation, in the direction of the margin of the eyelid; and then having taken hold of, and drawn it forwards with a pair of forceps, we are to separate it, throughout its whole length, from the inside of the upper eyelid, proceeding from the external, towards the internal angle of the eye, as far as the body, or middle of the encanthis. We are then to do the same to the lipomatous appendage on the inside of the lower eyelid. Afterwards the body of the encanthis is to be elevated, if possible, with a pair of forceps; but when this instrument will not answer the purpose, a double hook must be employed. This middle portion is now to be detached, partly with the bistoury, and partly with the curved scissors, from the subjacent conjunctiva, on the globe of the eye, from the semilunar fold, and from the caruncula lachrymalis; dividing the substance of this last part more or less deeply, according to the depth and hardness of the large inveterate encanthis. Here it is proper to state distinctly, that when we have to deal with an old, large tumour of this nature, deeply rooted in the caruncula lachrymalis, it is not regularly in our power to preserve a sufficient quantity of the substance of this part, to prevent the tears from dropping over the cheek, after the wound is healed.

The eye is to be repeatedly washed with cold water.

The rest of the treatment, consequent to the extirpation of a large encanthis, is almost the same as what was explained in speaking of the small incipient case. Bathing the eye very frequently in the lotion of mallows, and employing anodyne, detergent collyria, are the best local means, until the mucous appearance, preceding suppuration, has taken place on the surface of the wound. Then we may have recourse to mild astringent ointments and collyria. The mildest topical applications are generally the best, both in the first stage of suppuration, as well as afterwards, particularly, when, together with the encanthis, a considerable piece of the conjunctiva, covering the eyeball towards the nose, and intimately connected with the body of the excrescence, has been removed.

One enlargement of the lachrymal caruncle admits of cure by the application of leeches, repeated scarifications, and the nitrate of silver. (See *Middlemore on Diseases of the Eye,* vol. ii. p. 546.)

Consult *Scarpa* sulle Malattie degli Occhi, ed. 5. cap. 12. *Richter*, Anfangsgr. der Wundarzn. band. 2. p. 473, &c. edit. 1802. *G. J. Beer*, Lehre von den Augenkr. b. ii. p. 187. 8vo. Wien, 1817. *B. Travers*, A Synopsis of the Dis. of the Eye, p. 103, &c. *G. J. Guthrie*, Lectures on the Operative Surgery of the Eye, 8vo. Lond. 1823. p. 117, &c. *R. Middlemore*, On Dis. of the Eye, vol. ii. p. 545. 8vo. Lond. 1835. *Wm. Mackenzie*, on Dis. of the Eye, ed. ii. p. 254. 8vo. Lond. 1835.

ENCEPHALOCELE. (From ἐνκεφαλος, the brain, and κήλη, a tumour.) A hernia of the brain. (See Hernia Cerebri.)

ENCYSTED TUMOURS. (See Tumours, Encysted.)

ENEMA. The following are some of the most useful glysters employed in the practice of surgery.

Cathartic.

℞. Decocti hordei ℔j.
Sodæ muriatis ℥j.—Misce.

℞. Decocti avenæ ℔j
Olei olivæ ℥ij.
Magnesiæ sulphatis ℥j.—Misce.

Anodyne.

℞. Mucilaginis amyli, Aquæ distillatæ sing. ℥ij. Tincturæ opii guttas xl.—Misce.

℞. Olei olivæ ℥iv. Tincturæ opii guttas xl.—Misce.

The two latter are particularly useful, when great irritation exists about the rectum, bladder, or urethra. They have great effect in diminishing spasmodic affections of this canal and neck of the bladder. Hence they are often employed in retention of urine, in which cases their total quantity should not exceed two, or three ounces, which will be more likely, than a larger quantity, to remain within the bowel a sufficient time to let the anodyne qualities of the opium have the desired influence.

Tobacco,

Employed in cases of strangulated hernia.

℞. Nicotianæ ʒj. Aq. ferventis ℔j. The plant is to be macerated ten minutes, and the liquor then strained for use. One half should be first injected, and soon afterwards the other, unless the glyster operate with dangerous violence, as it sometimes does in particular constitutions.

ENTEROCELE. (From ἔντερα, the bowels, and κήλη, a tumour.) A hernia, the contents of which are intestine.

ENTERO-EPIPLOCELE. (From ἔντερα, the bowels, ἐπίπλοον, the omentum, and κήλη, a tumour.) A hernia, the contents of which are both intestine and omentum.

ENTROPIUM. (From ἐν and τρέπω, to turn.) An inversion of the eyelids. (See Trichiasis.)

EPIGLOTTIS SHOT AWAY. The practice of Baron Larrey furnishes a curious example, in which the epiglottis of a French soldier was shot off at the battle of Alexandria, on the 21st of March, 1801. The ball entered at the angle of the jaw, crossed the throat obliquely, and came out at the opposite side of the neck. The base of the tongue was grazed, and the epiglottis shot away; the patient spit it up after the accident, and showed it to the surgeon who first saw him.

The patient was not in much pain; but, his voice was hoarse, feeble, and scarcely audible.

When he first attempted to swallow, he was seized with a convulsive suffocating cough, attended with vomiting. Annoyed by thirst, which the extreme heat of the weather and the irritation of the wound excited, he incessantly repeated his attempts to drink; but, always with the same result. Four days were passed in this deplorable condition. He already experienced violent complaints in his stomach; continual loss of sleep; he had a small accelerated pulse; and was beginning to look thin.

If the patient had been abandoned to the resources of nature, he would have died in the course of a few days. The most urgent indication was to appease the hunger and thirst. An elastic gum tube was introduced into the pharynx, and by means of it, the patient was given some drink, which relieved him much, and afterwards some rich broth. The patient was fed in this manner for six weeks, at the end of which time he was able, without the assistance of the tube, to swallow thick panado, and thickened rice, made into little balls. The power of speech and deglutition in time became more perfect; in consequence, as Larrey imagines, of an enlargement of the arytenoid cartilages, and an expansion of that part of the base of the tongue which lies next to the glottis having formed a sort of substitute for the epiglotti. (*Mém. de Chir. Militaire*, t. ii. p. 145—149.)

The foregoing case illustrates the utility of elastic gum tubes for conveying nourishment and medicines down the œsophagus in some wounds of the throat. All practitioners should be duly impressed with the necessity of having such instruments always at hand. The patient, whose case is above recited, owed his preservation altogether to this means, without which he must have been starved to death.

In the 4th vol. of the above work, p. 247, is recorded another case, in which a gunshot wound, that took away the epiglottis, and broke the os hyoides, was successfully treated.

EPIPHORA. (From ἐπιφέρω, to carry with force.) By this term is meant an accumulation of tears on the anterior part of the eye; in consequence of which, the person affected is not only under the necessity of frequently wiping them away, but vision is injured by the morbid refraction, which they produce of the rays of light that enter the pupil. *Stillicidium lachrymarum* is distinguished by modern writers from epiphora: the cause of stillicidium lies in some obstacle to the absorption and conveyance of the tears from the lacus lacrymarum into the sac. Epiphora, on the other hand, consists in a superabundant secretion of tears, and is a disease of the secreting, not of the excreting, parts, of the lachrymal organs. (See *W. M. M'Kenzie's valuable Essay on the Diseases of the Lachrymal Organs*, p. 47. 8vo. Lond. 1819; and *Beer, Lehre von den Augenkr.* b. ii.)

EPIPLOCELE. (From ἐπίπλοον, the omentum, and κήλη, a tumour.) A hernia, formed by a protrusion of the omentum. (See Hernia.)

EPULIS. (From ἐπι, upon, and οὖλα, the gums.) A small tubercle on the gums. It is sometimes cancerous. The best plan of cure is to extirpate it with a knife.

ERETHISMUS. (From ἐρεθίζω, to irritate.) The state of irritation, attending the early stage of acute diseases. Mr. Pearson has described a state of the constitution produced by mercury acting on it as a poison. He calls it the *mercurial erethismus*, and mentions, that it is characterised by great depression of strength, anxiety about the præcordia, irregular action of the heart, frequent sighing, trembling, a small, quick, sometimes intermitting pulse, occasional vomiting, a pale contracted countenance, a sense of coldness; but the tongue is seldom furred, nor are the vital and natural functions much disturbed. In this state, any sudden exertion will sometimes prove fatal. Mr. Pearson advises, with a view of preventing the dangerous tendency of this affection, the immediate discontinuance of the use of mercury; and exposing the patient to a dry cool air. The incipient erethismus may often be averted by the camphor mixture and large doses of ammonia, if mercury be also left off. Sarsaparilla is also beneficial, when the stomach will bear it. (*Pearson on Lues Venerea*, p. 156, &c. edit. 2.)

ERYSIPELAS. (From ἐρύω, to draw, and πέλας, adjoining.) St. Anthony's fire; so called, from its tendency to draw the neighbouring parts into the same state, or its propensity to spread. Sometimes the term is believed to be derived from ερυθρὸς, *red*, and from πελος, *the skin*.

Erysipelas may be defined to be a cutaneous inflammation, attended with redness, which disappears, and leaves a white spot for a short time after being touched with the end of the finger; and the affection, which is irregularly circumscribed by a defined line, is characterised by a remarkable propensity to spread.

The part is generally of a bright red colour, clear, and shining. The disorder is not accompanied by throbbing; and a burning heat and tingling are felt, rather than acute pain. If the skin alone be affected, there is hardly any perceptible swelling, and no tension; "yet some difference is perceived between the sound and the inflamed part by passing the finger over it." In many instances, vesications arise; a circumstance which led Dr. Willan to include the disease in the order *Bullæ*. However, if we mean this arrangement to extend to what is named *local*, or *accidental erysipelas*, as well as to the *idiopathic* forms of the disorder, there cannot be a doubt of its inaccuracy, many examples of erysipelas from local irritation being characterised neither by fever nor vesications.

Desault preferred the division of erysipelas into *phlegmonous*, *bilious*, and *local*. (*Chir. Journ.* vol. ii.) Mr. Pearson divided the complaint into three forms, viz. *phlegmonous*, *œdematous*, and *gangrenous*. (*Principles of Surgery*, chap. x.) Burserius notices, 1. The *idiopathic*, or *primitive* erysipelas, or that which arises spontaneously from an internal cause, unpreceded by any other disease. 2. *Symptomatic* or *secondary* erysipelas, depending on another affection, by which its progress is completely influenced. 3. *Accidental* erysipelas, or that which is casually excited by some external manifest cause. *Instit. Med. Prac.* t. ii. c. 2. 8vo. Lips. 1798.)

The division adopted by Mr. Lawrence is into *erythema*, *simple*, *œdematous*, and *phlegmonous erysipelas*. By erysipelas he understands " inflammation of the skin, either alone, or in conjunction with that of the subjacent adipous and cellular tissues. Like other inflammations (he says), it varies in degree. When it affects the surface of the skin, which is red, not sensibly swelled, soft, and without vesication, it is called *erythema*. *Simple erysipelas* is a more violent cutaneous inflammation, attended with effusion into the cellular substance; and generally with vesication: *phlegmonous erysipelas* is the highest degree of the affection, involving the cellular and adipous membrane, as well as the skin, and causing suppuration and mortification of the former." (See *Med. Chir. Trans.* vol. xiv. p. 2.) When erysipelas, however, is defined to be inflammation of the skin, a peculiar kind of inflammation must be implied; for the skin, like all other parts, is often the seat of common inflammation.

In *phlegmonous erysipelas*, termed by Dupuytren *diffuse phlegmon*, (*Clin. Chir.* t. ii. p. 289.), the skin is more raised than in the simple form of the complaint, the swelling is harder and deeper, and of a darker colour. The redness has often a brownish, or dark livid tint; and the discolouration is sometimes irregular, giving to the part a marbled appearance. The tumefaction is more considerable than in simple erysipelas, the whole depth of the adipous and cellular textures being loaded with effusion, so that the arm or leg appears of twice the natural size. The sensation of heat and pain is aggravated in a very severe degree, and may be accompanied with throbbing. The swollen part at first yields slightly to the pressure of the finger, but subsequently becomes tense and firm. Vesications, often minute and miliary, form on the surface, with purulent contents; but, sloughing of the cellular tissue soon comes on, and the febrile symptoms are aggravated. According to Mr. Lawrence's observations, these dangers are not attended with increased swelling, elevation, and pointing, as in phlegmon; on the contrary, there is rather a diminution of tension, a subsidence, and a feel of softness in the part. A similar account is given by Dupuytren, who states, that, when the disorder has reached the period when phlyctenæ have formed, and the cellular tissue becomes thickened and indurated, the symptoms appear for two, three, or four days to be stationary; and an inexperienced surgeon is even led to hope for the resolution of the inflammation, while the danger is really urgent, and suppuration already exists. (See *Clin. Chir.* t. ii. p. 311.) Experience alone can teach the practitioner to distrust this deceitful stage, and not to neglect to practise timely punctures or incisions. In fact, as Dupuytren observes, in two or three days, if the disease be allowed to make progress, the skin separates from the subjacent parts, and breaks, or the phlyctenæ give way; a dark-coloured serosity flows out; and white, or sometimes black sloughs are visible under the skin, which extend with rapidity. (*Clin. Chir.* t. ii. p. 312.) At first, the cellular texture contains a whey-like or whitish serum. The fluid gradually becomes yellow and purulent, and we often find it presenting all the characters of good pus, and very thick. The serum is diffused through the cells at an early period, and a mixture of serum and pus often fills a considerable portion of the cellular texture, without any distinct boundary. Frequently matter is deposited in small separate portions, forming a kind of little abscesses, which often run irregularly in the cellular texture. This texture turns gray, yellowish or tawny, and sometimes appears like a dirty spongy substance filled with a turbid fluid: thus losing its vitality altogether, it is converted into more or less considerable fibrous shreds, of various size and figure, which come away soaked with matter like a sponge. The integuments over a large slough of this kind, being deprived of their vascular supply, become livid, and often lose their vitality. The suppurating and sloughing processes go on to a great extent when an entire limb is affected, sometimes completely detaching the skin, and often separating it through a large space; occasionally penetrating deeper, passing between the muscles, causing inflammation of them, suppuration between them, and often sloughing of the tendons. When the substance of a limb is thus generally inflamed, the joints do not escape; inflammation of the synovial membranes, effusion of matter into the joint, and ulceration of the cartilages take place. (See *Hutchison's Practical Obs.* p. 115. ed. 2; and *Bibl. Med.* Sept. 1827. p. 331.) Dupuytren refers to cases, in which a quart of matter was discharged daily, and to one fatal instance in the Hôtel Dieu, where the whole leg was stripped of the skin and cellular tissue, and the tibia and patella denuded. (See *Clin. Chir.* t. ii. p. 314.) If, however, the patient should recover after tedious suppurations and discharge of sloughs, the parts, which have been inflamed, are so changed in structure, and skin, fascia, muscles, tendons, and bones, are so materially agglutinated and fixed, after the extensive destruction of the connecting cellular texture, that the motions of the part are permanently and seriously injured. (See *Lawrence, in Med. Chir. Trans.* vol. xiv. p. 12.)

The attack of phlegmonous erysipelas, and especially of the spontaneous form of it, is announced by a greater or less degree of shivering, which is followed by heat, and febrile disturbance. The fever, though of the continued type, has paroxysms and remissions, two or three times a day. A slight uneasiness in the skin is often felt twenty-four or thirty-six hours before the shivering takes place. The skin afterwards assumes a rose colour, which is not uniform, but has a winding appearance; and in this stage, whether the case is to be simple or phlegmonous erysipelas, would be difficult to prognosticate, were it not for a degree of œdema in the subcutaneous cellular texture, and the *pitting* caused by the pressure of the finger. Afterwards the symptoms increase, the fever is redoubled, and the finger, strongly pressed upon the skin, no longer makes an impression or hollow in it; but, on the contrary, feels a considerable resistance; the redness, which is intense, assumes a darker, or even a purplish colour; the skin becomes shining; phlyctenæ arise; the cellular tissue is dense and indurated; the urinous and other secretions are diminished, altered, or suppressed; and the patient is in a constipated, sleepless, and extremely agitated state. (See *Dupuytren in Clin. Chir.* t. ii. p. 310.)

In *simple erysipelas,* the skin is preternaturally red and shining, having a light or rosy tint in the early stage and slighter cases of the affection; whence, in some languages, it has received the popular appellation of the *rose;* whilst, in other instances, it is of a bright scarlet, or even a deep and livid red. The colour disappears on pressure, returning as soon as the pressure is removed. If the skin alone be affected, there is hardly any perceptible swelling, and no tension; yet some difference is perceived between the sound and the inflamed part, by passing the finger over it. Erysipelas, however, is found by Mr. Lawrence to be seldom confined to the skin, except in the slightest cases; effusion soon takes place into the cellular texture, causing a soft swelling; and this may be considerable, together with much tension and a shining surface, when a large part of the body, or an entire limb, is involved. The inflamed part is hot and painful; at first, a stinging or itching is felt, which soon becomes a sharp, smarting, and burning sensation, with acute pain on pressure. The pain is not so intense and unremitting as in phlegmon; nor is it attended with throbbing. This kind of inflammation often ends by resolution; the redness and other symptoms disappearing, and the skin recovering its natural state, with or without desquamation of the cuticle. Frequently serous effusion takes place from the inflamed surface, elevating the cuticle into smaller or larger vesicles, or into bullæ like those produced by blisters; or raising it by a soft, yellow, jelly-like deposit, which remains slightly adherent to both the cutis and cuticle. The contents of the vesicles or bullæ, are transparent, sometimes nearly colourless, but more commonly yellowish; sometimes they consist of a thin pus; or they may exhibit a bloody or livid discoloration. The fluid loses its clearness, becoming thicker, opaque, and whitish, or yellowish. The cuticle gives way; the fluid escapes, and incrustations form, which soon fall off, leaving the skin sound; or they may lead to superficial ulcerations. Erysipelas sometimes produces gangrene; but this is a comparatively rare occurrence. So long as this inflammation is confined to the skin, it does not produce suppuration; and the affection of the cellular structure is too slight for that termination in most cases of simple erysipelas. It may, however, become more severe at one point; and thus we occasionally see the formation of abscess under the skin towards the decline, or after the disappearance, of the general erysipelatous redness. This inflammation generally attacks a considerable surface of the skin, the inflamed part being irregularly circumscribed by a defined line. It spreads quickly to the neighbouring skin, declining and disappearing in the part first affected. Thus, we commonly see the various stages of erysipelas existing together at the same time in different parts of the skin; the portion last affected is red and swelled; another part is vesicated; while others exhibit incrustation and desquamation. Sometimes it leaves the part first affected to appear in a distant situation. Its origin, development, and complete termination, seldom take place in one and the same spot. The neighbouring absorbent glands are frequently inflamed, and red streaks are sometimes seen leading to them. (See *Lawrence,* in *Med. Chir. Trans.* vol. xiv.)

A little before the appearance of the redness, and sometimes during several previous days, the patient experiences considerable indisposition; loses his appetite; has shiverings and violent pain in his head, accompanied sometimes with vomiting, and always with weakness and dejection. Frequently bilious complaints occur, attended with a bitter taste in the mouth, and fetid eructations from the stomach. The tongue is moist, and covered with a yellow mucus. The patient afterwards has a dry parched skin; constipation; an accelerated pulse; thirst, and other common symptoms of fever. Blood drawn from a vein exhibits in a greater or less degree the inflammatory character. "Often, particularly when the head is the seat of erysipelas, the sensorium is principally affected, and symptoms are of the kind called nervous, such as pain and oppression of the head, sleepiness, coma, or delirium. The tongue in such cases becomes dry and brown; but, according to Mr. Lawrence, this state of the organ is often owing principally to the circumstance of the patient breathing entirely through the mouth; the pulse is rapid and feeble, and there is great loss of muscular strength; in short, the symptoms at length are those called typhoid. In other cases, the circulation and the nervous system are not much affected; but, there is pain in the epigastric region, foul tongue, with bad taste in the mouth, nausea, and constipation; that is, so many indications of disordered stomach and intestinal canal, to which, as its cause, the local affection must be referred." (*Med. Chir. Trans. Obs.* xiv. p. 6.) This last form of the complaint has been termed by Desault and others, *bilious erysipelas.* In phlegmonous erysipelas which is attended with phlyctenæ, the urinary and other secretions are altered and diminished, or even quite suppressed. Constipation prevails; the patient is sleepless; and the general derangement is excessive. Mr. Lawrence represents phlegmonous as differing from simple erysipelas, merely in the higher degree and deeper extent of the inflammation, which not only occupies the whole thickness of the skin, and subjacent adipous and cellular tissues, but soon proceeds in the latter to suppuration and sloughing, the skin itself being often involved secondarily in the mortification. Other writers, however, regard as examples of phlegmonous erysipelas, cases, which perhaps would not be comprehended in the above view; and, in fact, the exact line, that should divide one form of erysipelas from another, does not always admit of being drawn. The affected part, which is at first firm, becomes softer, when diffused suppuration and matter mixed with sloughs are under the skin. Experience proves that the seat of phlegmonous erysipelas is in the skin and cellular substance, and that the disease does not generally extend beneath the fascia.

Mr. Lawrence differs from Mr. Hutchison, in having always found the aponeuroses unaffected in examination after death, and seen no symptoms referrible to such an inflammation during life. "They may indeed become involved in the disease when it is violent, and they must suffer partially when it extends to the intermuscular cellular texture, but they are not primarily affected in these cases, while, in the majority of instances, they do not suffer at all." (*Med. Chir. Trans.* vol. xiv. p. 16.)

According to several writers, the seat of erysipelas in the greater number of cases is the very surface of the cutis; its most vascular and nervous part. (*Dict. des Sciences Méd.* t. xiii. p. 255.) Perhaps it may be true, that simple erysipelas commences here, and is most intense; yet, the affection generally extends more deeply, and affects the subjacent cellular tissue, particularly in cases of phlegmonous erysipelas, which is even believed by Dupuytren to be the texture in which it begins. The researches of Mr. Lawrence have taught him, as already noticed, that erysipelas is seldom confined to the skin, except in the slightest cases; effusion soon takes place into the cellular texture, causing a soft swelling; and this may be considerable together with much tension and a shining surface, when a large part of the body, or an entire limb, is involved. (See *Med. Chir. Trans.* vol. xiv. p. 3.) The affection of the cellular tissue, however, s very different from what happens in phlegmonous inflammation. In true erysipelas, healthy pus is rarely found enclosed in a circumscribed cavity; and when there is any secretion of purulent matter, a feel is communicated, on compressing the part, almost like that which a sponge would give. In such cases, the cellular tissue is frequently gangrenous.

Excepting cases on the lower extremity, phlegmonous erysipelas frequently ends in resolution; but, in the lower limbs, it has a great tendency to suppuration. Here the cellular tissue has as great a disposition to suppurate, as that of the eyelids or the scrotum. This consequence, when it happens, is always productive of a great deal of mischief; for the pus collects not in one cavity or mass, but numberless distinct points, and large flakes of the cellular tissue perish. Thus, Dupuytren observes, that he has often taken out some portions of it, which were six or seven inches in length. Nor is this all; for the skin frequently assumes a dark purple colour, and sloughs, rather from defect of nutrition than from inflammation. As is remarked by this eminent surgeon, such mortification of the skin is very common in the leg, where the nutrient arteries, the tibial and peronæal, being deeply placed, only communicate with the integuments by small ramifications, and where the destruction of the cellular tissue occasions a destruction of almost all those slender vessels. But, on the head, this kind of mortification is exceedingly rare, though phlegmonous erysipelas in that situation is remarkably common. This difference is ascribed by Dupuytren, to the distribution of the temporal, frontal, and occipital arteries, which, lie close under the skin, between it and the aponeurosis of the occipito-frontalis muscle. Hence, the supply of blood to the skin is not much interrupted, even though the cellular tissue under that aponeurosis become the seat of suppuration in phlegmonous erysipelas. In fact, Dupuytren had never seen but one example i which the skin of the head mortified in consequence of phlegmonous erysipelas. (See *Dupuytren, in Clin. Chir.* t. ii. p. 295.) The rarity of the termination of phlegmonous erysipelas of the face in suppuration, is noticed by Bateman. (*Synopsis, &c.* p. 127.)

Every surgeon is well aware, that one cause of erysipelatous inflammation, is a fever of a determinate and peculiar nature, one feature of which is the invariable production of this kind of inflammation upon the surface of the body.

With respect to the causes of erysipelas, it is the opinion of Mr. Lawrence, that no difference prevails on this point between erysipelas and other inflammations. "The habitual excitement of the vascular system, or the long-continued disturbance of the stomach, alimentary canal, and liver, consequent on intemperance and excess, lay the foundation of inflammation generally, and it depends on individual peculiarity, or on local causes, whether the skin or other parts shall be the seat of the disease. In most cases of erysipelas, the bilious and digestive systems are more or less actively disordered, such disorder appearing sometimes to produce the cutaneous affection, sometimes to be excited sympathetically by it. Hence Desault established the denomination of *bilious*, in contradistinction to *phlegmonous*, erysipelas; on which division it may be observed, that the symptoms called bilious are commonly found also in phlegmonous cases." (*Med. Chir. Trans.* vol. xiv. p. 36.) Erysipelas may arise from external irritants of all kinds; from heat, or cold; blisters, issues, setons, caustics, or other acrid matters applied to the skin; from wounds, punctures, bruises, surgical operations, and all kinds of injury. The mechanical or chemical irritation of wounds, ulcers, or other local diseases, will cause it. "Neglect of previous preparation, inattention to diet, injudicious modes of dressing, continued exercise of the affected part, and an imprudent degree of general exertion, are frequent causes of erysipelas after operations and wounds, and in the course of ulcers and other local affections. When these several points are properly attended to, we shall not be much troubled with traumatic and hospital erysipelas. Irritating plasters, a heating load of dressings, and tight bandaging, are common causes of erysipelas, whether in the case of wounds, or operations. Light applications, and keeping the parts cool, are simple but effectual preventives. The most frequent source, however, of this affection, after accidents or operations, is improper diet, that is, indulgence in animal food, or fermented liquors." (*Lawrence*, vol. cit. p. 38.) Another very common source of erysipelas after wounds, is the indiscriminate use of sutures.

In most cases, erysipelas would seem to be intimately dependent on the state of the constitution. Thus, persons in the habit of drunkenness, and other kinds of intemperance, and who, in a state of intoxication, meet with local injuries, often have erysipelatous inflammation in consequence of them. Other subjects, who lead more regular lives, experience, when they meet with similar injuries, healthy phlegmonous inflammation.

A further proof, that erysipelas is mostly dependent on constitutional causes, is, that the affection is particularly frequent in autumn, or in any season when hot weather is succeeded by cold and wet.

Erysipelas attacks both sexes; but women are thought to be rather more subject to it than men; and the reason for this circumstance, generally mentioned, is the greater delicacy and tenderness of the skin in females. But it would be quite as rational to suspect their weaker and more irritable constitutions, and their sedentary mode of life. In lying-in hospitals, and other charities for the reception of children, new-born infants are often afflicted with a species of erysipelas, which begins in the umbilical region, and thence extends to the pudenda. This case, which sometimes terminates in gangrene, and proves fatal, has been ascribed by some writers to injury done to the naval-string during labour, and by others to the bad air frequently allowed to accumulate in establishments of the above description; a cause, which too often renders complaints, which are at first trivial, ultimately fatal.

Sometimes the complaint is scarcely cured in one place, when it makes its appearance in another; and when this tendency is evinced in a great degree, the case is termed *erysipelas ambulans, vel erraticum.* La Motte has published a striking instance of this form of the disease. A child, between nine and ten years of age, was attacked with erysipelas of the scalp, forehead, and ears, which afterwards extended to the neck and then to the shoulders, while the scalp and face became free from it: in proportion as the disease spread downwards, all the upper parts got well, so that, in the end, there was no portion of the surface of the body which had escaped, even down to the fingers and toes, the parts last of all affected. (*Obs. Chir.*)

An uncommon variety of disease is an *universal erysipelas.* No disorder is more subject, than the present, to relapses; but a remarkable thing, sometimes attending the return of the complaint, is its being sometimes strictly *periodical.* In chlorotic women, the erysipelatous attack is occasionally made every month just at the period when the menses should take place. (*Hoffman.*) This periodical nature of erysipelas has been observed in men: Larrey knew two male patients, one of whom used to be attacked with erysipelas twice a year at the time of the equinox; the other had only one attack annually, which was wont to happen in the beginning of the spring. My friend, Mr. Maul of Southampton, once informed me of an erysipelas, which was both periodical and universal, affecting a lady several times at intervals of two years.

The doctrine is occasionally entertained, that erysipelas may be propagated by contagion. (*Wells, in Trans. for the Improvement of Med. and Surg. Knowledge*, vol. ii. art. 17. 1800. *A. Riberi, Sulla Gangrena Contagiosa, o Nosocomiale; con alcuni Cenni sopra una Resipela Contagiosa.* 8vo. Torino, 1821. *Arnott, in Med. Phys Journ.* vol. xvii. *Drs. M'Dowel and Brereton, in Dubl. Journ. of Med. Science,* vol. vi. p. 176.) But, as Dr. Bateman has truly remarked, such cases are, at all events, extremely rare, and perhaps never happen in well-ventilated and cleanly houses. (*Synopsis,* &c. p. 131.) In places of the opposite description, the infection of many individuals together might be explained by the operation of the same exciting causes upon them all, without any supposition of contagion. This part of the subject, however, is yet unsettled: Mr. Lawrence believes, that erysipelas of the face may be traced in some instances to contagion (see *Med. Chir. Trans.* vol. xiv. p. 39); though, in another part of the same paper, he pronounces the doctrine to be at least doubtful. To Dr. Tweedie the proofs of its truth appear, however, to be satisfactory; and, in support of this view, he refers to the papers of Dr. Wells, Dr. Stevenson, (*Edinb. Med. Chir. Trans.* vol. ii.) Dr. Gibson (*ib.* vol. iii.) Mr. Arnot (*Lond. Med. and Physical Journ. March,* 1827), see *Cyclop. of Practical Med.* art. *Erysipelas.* The following statement is made by Dr. Brereton, in favour of the opinion, that erysipelas may sometimes be contagious, at least in hospitals. The cases were in the temporary Fever and Dysentery Hospital in Keven Street, Dublin, in 1826 and 1827. The wards were extremely well ventilated and large. "On paying my daily visit, I observed one of the patients, who had been admitted with fever some days previously, to be formidably attacked with erysipelas. On the following day, I found the patient in the next bed seized with it. On the third day, two patients in the adjoining beds were similarly attacked. I then became seriously of opinion, that the disease was contagious, but, resolved not to have those already affected, removed until I had tried the result of another day. On the following morning, I found three more in like manner, labouring under the disease: and what made it more remarkable, they were all similarly attacked in the head and face. I had them immediately put into another ward, where there were no patients; they all recovered; and no more erysipelas afterwards appeared." (See *Dubl. Journ. of Med. Science,* vol. vi. p. 176.)

I think we must agree with Mr. Lawrence, that "a consideration of the origin, development, and effects of erysipelas, whether local or general, leads us irresistibly to the conclusion, that the nature of the affection is inflammatory. In its four leading characters, of redness, swelling, heat, and pain, and in its effects, of effusion, suppuration, and sloughing, it agrees with what is called common or phlegmonous inflammation; while the general disturbance, preceding and accompanying the local affection, is often exactly alike in the two cases. Erisipelas then is merely a particular modification of cutaneous, or cutaneous and cellular inflammation. If we were to class these according to their natural affinities, we should place erysipelas between the exanthemata and phlegmon. It is less diffused than the former, — not so circumscribed as the latter. The exanthemata are confined to the skin; erysipelas affects both skin and cellular structure; while phlegmon has its original seat in the latter, the skin being secondarily involved.

"The difference between erysipelas and phlegmon, however, is not merely in the original seat, or degree of the disturbance: there is also a difference in kind. We may, indeed, say, generally, that phlegmon is a more violent inflammation than erysipelas, but sloughing of the cellular substance is more frequent in the latter than the former. The most striking and important distinction between the two affections is, that inflammation is confined to one spot in phlegmon, and is distinctly circumscribed in its seat, while it is diffused in erysipelas, and spreads without limit. This difference seems to depend on the adhesive character of the inflammatory process in the former; the substance called coagulating, coagulable, or organisable lymph, effused around the inflamed part, forms a boundary between it and the sound portion, which is altogether wanting in erysipelas. In the latter, the effusion is serous; hence, when matter is formed, it is not confined to one spot, but becomes extensively diffused in the cellular tissue." (*Med. Chir. Trans.* vol. xiv. p. 17., &c.) These views correspond to those given by Mr. Hunter, whose original remarks on erysipelas are particularly valuable both to the pathologist and the practical surgeon.

Like phlegmonous inflammation, erysipelas may be excited by any local irritation. Like other inflammations, it may end in suppuration, though of a less perfect sort, than that in which phlegmon ends, the pus being rarely contained in a circumscribed cavity. The pulse, in phlegmonous erysipelas, is frequent, hard, sometimes full; and when the patients are bled, their blood has the same appearance, and is covered with the same kind of inflammatory crust, as the blood taken away in other kinds of inflammation.

Mr. Lawrence does not agree with some medical authors, amongst whom may be placed John Hunter, who regards erysipelas as a distinct species of inflammation, and capable of affecting various parts of the body as well as the skin. Some writers he says, have referred to erysipelas certain inflammations of the conjunctiva, mouth, and fauces; of the respiratory and alimentary mucous surfaces; of the serous membranes in the head, chest, and abdomen, and of the brain, abdominal and thoracic viscera. The distinguishing characters of erysipelas, Mr. Lawrence refers to the peculiarities of the cutaneous and cellular structures in which it occurs, and he therefore infers that such an affection cannot exist in parts so differently organised as serous membranes, and the viscera. When the remarks of some of these writers are carefully considered, it seems as if their meaning were only, that erysipelas is connected with a particular state of constitution, in which the inflammation, wheresoever situated, would have a tendency to spread rapidly and extensively. If, however, the frequent extension of the inflammation to the mucous membrane of the cheek, in erysipelas of the face, and even its extension in some of these cases, by the Eustachian tube into the tympanum, as ascertained by Dupuytren by *post mortem* examination; and if an erysipelatous affection of the rectum, as described by Sir Benjamin Brodie; (See *Lond. Med. Gaz.*) be positive occurrences, then a mucous membrane, as well as the skin, must undoubtedly be admitted to be susceptible of erysipelas.

Treatment of Erysipelas.

Simple erysipelas not exceeding a certain degree of severity, yields to mild purgatives, and a light vegetable diet, with which remedies practitioners usually conjoin diaphoretics and the saline mixture. Whether bleeding is right, or not, in this species of erysipelas, is a point, on which different sentiments prevail. I believe, however, that venesection, in the milder forms of the complaint, is now generally allowed to be as unnecessary as it is urgently required in more severe examples. It is rather a prevalent notion, that it is unnecessary to repeat bleeding in erysipelas so frequently as is done in other inflammatory diseases. We ought to be guided, however, in this respect, by the violence and extent of the inflammation, the state of the pulse, and other symptoms, never forgetting the patient's age, strength, and other important considerations. Another common belief is, that the patient will bear bleeding better in the country, and in an open, pure air, than in a large city, and, especially, in an hospital. And, it is remarked, that unless there be a considerable tendency to delirium, or coma, blood-letting can seldom be repeated with advantage, at least in large towns. (*Pearson's Principles of Surgery. Bateman's Synopsis*, p. 132. ed. 3.) Instead of this practice, the latter author recommends local bleeding and blistering, but *not upon*, or *very near, the diseased surface*, whereby he avoids producing troublesome sores, the frequency of which, in former times, after taking blood from erysipelatous parts, led Mr. B. Bell to pronounce a general condemnation of the method. I ought to observe, in relation to the above-mentioned fear of bleeding patients freely in large cities, that it is an hypothesis which seems to be declining, many experienced and judicious surgeons having actually rejected it as unfounded; and so far as my observations extend, I have no hesitation in stating my opinion, that the abstract consideration, whether a person be living in town or country should not regulate the use of the lancet, which ought to be decided by other more important circumstances in the case. Alexander of Tralles, and Paré, had a high opinion of the beneficial effects of plenty of fresh, cool air in erysipelas; but good air is generally beneficial in all diseases, and, perhaps, not more so in erysipelas than other disorders.

Mr. Lawrence thinks, that as erysipelas resembles other inflammations in its causes, symptoms, and effects, it should be treated on the same principles; that is, on the antiphlogistic plan. Venesection, local bleeding, purging, and low diet are the first measures, to which saline and diaphoretic medicines may be afterwards added. He says, the earlier these means are employed the better: vigorous treatment in the beginning seems to him most calculated to shorten the attack, and prevent the disease from spreading beyond its original seat. At the same time, he admits, that as the skin and cellular texture are of secondary importance, it is not so urgently necessary to arrest inflammation in them, as in the vital organs; neither does the same reason for very active treatment exist as in affections of the eye, where a slight change of structure may seriously impair the utility of the organ essential to our comfort and pleasure; but the extensive suppuration and mortification, which erysipelas sometimes produces, may render a limb, in a great measure, totally useless, or may even destroy life. "The disposition of erysipelas to terminate by resolution, is another reason against resorting indiscriminately to active depletion. In many cases, the disease passes through a certain course, and ends spontaneously: it is sufficient to put the patient on low diet, to clear the alimentary canal, and then to use mild aperients and diaphoretics. When it proceeds, as it often does, from an unhealthy condition of the alimentary canal, the removal of the internal disorder leads to the cessation of the local complaint. It must, however, be observed, that venesection is sometimes useful both in curing the internal cause and in promoting the termination by resolution." Mr. Lawrence afterwards observes, that he does not mean to recommend that measures equally active, and, in particular, that bleeding, whether general or local, are to be employed in all cases. In young persons, in the robust, and those of full habit; in instances where the pulse is full and strong, or where there is headach and white tongue; in erysipelas of the head, attended with symptoms denoting affection of the sensorium, and more especially in the very beginning of the affection, venesection will be proper; and it may be necessary to bleed largely, to repeat the evacuation, or to follow venesection by local abstraction of blood. Under such circumstances, the other parts of the antiphlogistic plan must also be employed, that is, the alimentary canal should be cleared by an active purgative, which may be followed by salines and antimonials, with the occasional use of milder aperients, and low diet should be enjoined. As Mr. Lawrence adds, nothing can be more different from such a case, than that of an elderly person, with a small and feeble pulse, in the advanced stage of the disease. The interval between these extremes is filled by numerous gradations, requiring corresponding modifications of treatment. The antiphlogistic plan itself embraces a wider range in point of degree; from blood-letting local and general, with purging, vomiting, the free use of mercury and antimony, and low diet, to the exhibition of a mild aperient, with some saline medicine. Mr. Lawrence believes, that the treatment of erysipelas, like that of any other inflammation, should be modified according to the age, constitution, previous health, and habits of the patient, and the period of the complaint. "In asserting generally that the antiphlogistic treatment is proper, I speak (says he) of the beginning of the disease, when the original and proper character of the affeetion is apparent; and I am decidedly of opinion, that, in some shape or degree, such treatment will always be beneficial in that stage. In many instances, active antiphlogistic measures are of the greatest service in lessening the severity, both of the local and general symptoms. In others, the administration of calomel with aperients, and of diaphoretics with low diet, will be sufficient. When the affection occurs in old and debilitated subjects, the powers of life are soon seriously impaired, and our efforts must be directed rather towards supporting them, than combating the local affection. I have often seen such subjects, labouring under erysipelas of the face in its advanced stage, with rapid and feeble pulse, dry and brown tongue, recovered, under circumstances apparently desperate, by the free use of bark and wine." The same writer deems local bleeding sufficient in the milder cases of erysipelas, and often necessary in the more severe ones, as an auxiliary measure. Cupping, when practicable, he sets down as more efficacious than leeches, though objectionable on account of the painful state of the skin. Leeches, he remarks, when applied to the sound skin of some individuals, produce an effect analogous to erysipelas, but they exert no such influence over the inflamed skin, to which they may be applied freely and safely. In order to produce any decided benefit, he thinks that they should be applied in large numbers.

The authorities, which may be cited in favour of the treatment of erysipelas on antiphlogistic principles, are Sydenham; (*Obs. circa Morborum Acut. Hist. &c.* sect. 6. c. 6.) Cullen; (*Works by Thomson*, vol. ii. p. 188.) Richter; (*Anfangsgr. der Wundarz.* vol. i. § 188.) Vogel; (*Handb.* vol. iii. p. 348.) J. P. Frank; (*De Cur. Hominum Morbis*, lib. iii. p. 54.) Dr. Duncan, junior. (*Edin. Med. Journ.* vol. xix.) Several of these writers consider bleeding more particularly proper when erysipelas is seated on the head and face.

As Mr. Lawrence has noticed, high authorities may also be brought forward against the use of the lancet in erysipelas, and most of them are comparatively of modern date. Some of them not only object to evacuations of all kinds, but recommend tonics and stimuli, such as bark, ammonia, and wine. Dr. Fordyce declares, that he always found bleeding and evacuations hurtful, and Peruvian bark the best remedy. "It should be exhibited (he says) in substance, if the patient's stomach will bear it, and in this disease it will almost always bear it, and in as great a quantity as the patient's stomach will bear, which is commonly to the quantity of a drachm every hour!" (*Trans. of a Society for the Improvement of Chir. Knowledge*, vol. i. p. 293.) Some animadversions on the practice of giving bark in this manner will be found in our preceding columns. (See CINCHONA.) Dr. Wells is also an advocate for the treatment recommended by Fordyce. With regard to Cullen, he only sanctioned it when the case was attended with typhoid symptoms.

After the inflammation has been checked by antiphlogistic means, the surgeon should not be in too great a hurry to prescribe tonics, stimulants, and a full diet. "Medical practitioners in general (says Mr. Lawrence) are anxious to begin the strengthening plan; they seem to have the fear of debility constantly before their eyes, and lose no time in directing the employment of bark, and recommending animal food, with beer or wine. In this way relapses are frequently produced; the inflammation and fever are renewed; further local mischief is caused, and recovery is retarded." (*Med. Chir. Trans.* vol. xiv. p. 59.) When it is doubtful whether stimuli should be employed or not, he deems subcarbonate of ammonia the best medicine. Bark comes next in order to it, and the sulphate of quinine is the most eligible preparation. Wine is sometimes necessary; but, Mr. Lawrence thinks it should be given sparingly. (See *Med. Chir. Trans.* vol. xiv.)

The proposal to treat erysipelas by compression with bandages, as adopted by Bretonneau and Velpeau, has proved in this country very unsuccessful. (See *Duncan*, in *Edin. Med. Chir. Trans.* vol. i. p. 543; *Lawrence*, in *Med. Chir. Trans.* vol. xiv. p. 65.) The application of blisters to erysipelatous parts, can only be entitled to the briefest mention, even when viewed as represented by the French surgeons themselves. (See *Roche and Sanson, Nouveaux Elém. de Pathol. Méd. Chir.* t. i. p. 352.)

A large blister was sometimes applied by Dupuytren over a wound, and to the surrounding skin; and he found that the irritation and suppuration which were thus excited, occasionally succeeded in preventing phlegmonous erysipelas. (See *Clin. Chir.* t. ii. p. 320.)

Indeed, it was only for the prevention of the disorder that Dupuytren sanctioned this practice, which, as he particularly explains, he was afraid of resorting to, after the disease had resisted bleeding and cold sedative lotions, because he had sometimes, though not often, seen sloughing produced by it. (*Ib.* p. 322.) The application of the nitrate of silver in substance, or in the form of a lotion, so as to blacken the part, appears to have considerable power as a means of checking the peculiar action of the vessels, on which erysipelatous inflammation depends. It tends to repress the effusion of serosity in the cellular tissue; and, if applied beyond the erysipelas, will form an obstacle to its spreading in any particular direction. By forming a black line with it, the inflammation may thus be kept from running up the neck to the face and head. The use of nitrate of silver in erysipelas has been particularly insisted upon by Mr. Higginbottom. (*On the Use of Nitrate of Silver.*) In the early stages of erysipelas I have often employed it with advantage in the North London Hospital; but it should not be continued too long; for when it fails to lessen the distension of the cellular tissue with serosity, the fluid should be discharged by puncture or incision. Mr. Higginbottom directs the part to be first washed with soap and water, and then dried. The inflamed and surrounding skin is then to be moistened, and the nitrate of silver passed over it once, twice, or thrice, and more frequently, if rapid vesication be required. The part is then to be exposed to the air and kept cool.

Of the good effect of mercurial ointment as an application to erysipelas, I cannot speak from experience. Dr. M'Dowel has tried mercurial unction, and makes a favourable report of it. In Mercer's Hospital, it was found also to have considerable power in checking the disease. Two, three, or four applications usually sufficed with other means. In most instances, the patients were salivated. (See *Dublin Journ. of Med. Science*, p. 6.)

In *bilious* erysipelas, or that originating with strongly marked gastric disorder, Desault gave, in the first instance, a grain of tartarised antimony dissolved in a considerable quantity of fluid. He had seen the symptoms entirely subside, although the medicine produced no other sensible alteration in the animal economy, than an increase of the insensible perspiration and urine. When the symptoms resisted these evacuations, he was obliged to have recourse once or twice, or even more frequently, to the emetic mixture. When the erysipelas was cured, and the bitterness in the mouth and fever had subsided, two or three purges of cassia and manna, with a grain of emetic tartar, were exhibited. As soon as the symptoms were mitigated, the diet of the patient was allowed to be more generous. In bilious erysipelas, Desault observed, that the cases of the patients, who had been bled previously to their admission into the hospital, were invariably the most obstinate.

When the tongue, without being red at its point and margins, was furred, and marks of gastric disorder prevailed, unattended with tenderness of the epigastrium, Dupuytren found emetics useful. (*Clin. Chir.* t. ii. p. 320.)

In cases of bilious erysipelas, many modern practitioners would be bolder with antimonials than Desault, first, by imitating Richter, and giving an emetic at the commencement of the attack, and then by exhibiting more freely either antimonial powder, or tartarised antimony, with a dose or two of calomel.

In *phlegmonous* erysipelas, Desault was an advocate for bleeding in the beginning of the disorder, and this practice he followed up by the administration of tartarised antimony and evacuants.

In the beginning of phlegmonous erysipelas, Dupuytren likewise had recourse to general and local bleeding, emollient applications, or what he considered still more efficacious, cold sedative lotions. If inflammation of the cellular texture had begun, he not only practised these antiphlogistic measures, but repeated them. But if there was a narrow wound, seemingly attended with strangulation of the parts, he made a simple or crucial incision without delay. (See *Clin. Chir.* t. ii. p. 320.) While cold lotions are used, the inflamed parts are to be kept in an elevated position in order to lessen the swelling.

Mr. Lawrence recommends, in the early stage, venesection, and the application of leeches in large numbers to the inflamed part, together with antiphlogistic treatment generally, in order to prevent the full development of the affection. The bleeding of the leech-bites he directs to be encouraged by fomentations, and cold lotions afterwards to be applied. When, however, the inflammation is more advanced (he says), the latter should be exchanged for fomentations and poultices. My own experience in these cases leads me to refer very great efficacy to cold applications, which I find particularly useful in checking the effusion in the cellular tissue, averting gangrene, and stopping the progress of the disorder. In the case of a patient in Fleet-market, whom I attended with Mr. Lawrence and Mr. Bullin, and whose limb was so swollen as to be nearly twice its natural thickness from one end to the other, cold lotions, evacuations, leeches, and other antiphlogistic remedies, had a decided effect in giving ease, and preventing all occasion for the practice of extensive incisions. The abscesses were very limited; and two small incisions, made at different periods, for the discharge of the matter, answered every purpose. After the bowels have been emptied, Mr. Lawrence prescribes freely calomel and antimony, with saline medicines. The local abstraction of blood, he considers more serviceable in phlegmonous erysipelas, than venesection. The latter, therefore, he advises to be reserved for instances, in which the patient is young and plethoric, the pulse full and strong, or the head much affected.

When such practice is unavailing, Mr. Lawrence finds the plan of making incisions, through the inflamed skin and the subjacent adipous and cellular textures, the most powerful means of arresting the complaint. If this be not done, (he says), the inflammation will now pursue its course, both in the cellular texture and skin, in spite of bleeding, whether general or local; suppuration and sloughing rapidly supervene; and these destructive processes soon extend over a large portion of a limb. It was with the view of preventing such consequences, that Mr. Lawrence, in imitation of Mr. C. Hutchison, tried the practice of making free, and even very extensive incisions in the inflamed parts.

In cases of *idiopathic* erysipelas, whether *phlegmonous* or *bilious*, external applications have been deemed useless or hurtful, by a large proportion of practitioners, amongst whom is Desault. In the early stage of this disease, Dr. Bateman found powdery substances, like flour, starch, chalk, &c. increase the heat and irritation, and afterwards, when the fluid of the vesications oozes out, such substances produce additional irritation, by forming with the concreting fluid hard crusts upon the tender surface. This practice is also condemned by Pearson. The only plan, perhaps, which is unobjectionable, as a means of allaying the irritation produced by the discharge from the vesication, is that advised by Dr. Willan, and which consists in fomenting or washing the parts from time to time with milk, bran and water, or a decoction of elder-flowers and poppy-heads. In the early stage of the inflammation, Dr. Bateman saw great relief derived from moderate tepid washing, or the application of the diluted liquor ammon. acet. (*Synopsis of Cutaneous Diseases*, p. 133. ed. 3.)

As for what is termed *accidental* erysipelas, or that caused by local irritation, applied directly to the skin, as from acrid substances, heat, friction, the sting of insects, &c. the removal of the cause, the employment of cold, or even ice-cold lotions, and other antiphlogistic means, are essentially necessary.

In *phlegmonous* erysipelas, if the inflammation continue in an unabated form beyond the seventh or eighth day, suppuration is to be apprehended. Here Boyer recommends the employment of emollient applications, and as soon as a fluctuation is distinguishable (or even what he terms "*un empâtement purulent*") he advises the surgeon to make such incisions as may be necessary for the discharge of the matter. He also states, that the incisions should be made at several depending points. (See *Boyer, Traité des Mal. Chir.* t. ii. p. 22.) It appears from the observations of my friend Mr. A. C. Hutchison, formerly surgeon to the Naval Hospital at Deal, that seafaring men are very liable to phlegmonous erysipelas of the legs. The cause is ascribed to the irritation of the salt water, and the friction of their loose coarse trousers. In this description of patients, the disease frequently proceeds rapidly to the gangrenous state, and the consequence is the loss of many lives and limbs. Even when the danger of mortification is avoided, abscesses often occur, which spread between the muscles and under the integuments to a surprising extent: "from the ankle to the trochanter, and over the glutæi muscles." In the first few cases, which came under the care of Mr. Hutchison, this gentleman's plan of treatment, in addition to the usual medical means, consisted of local bleeding by means of cupping glasses, followed by fomentations. Subsequently, however, he adopted the method of making several free incisions with a scalpel on the inflamed surface, in a longitudinal direction, through the integuments, and down to the muscles, as early in the disease as possible, and before any secretions had taken place. These incisions were about an inch and a half in length, two or three inches apart, and varied in number from six to eighteen, according to the extent of surface, which the disease is found to occupy. Mr. Hutchison states, that these incisions will yield between fifteen and twenty ounces of blood, and give relief to the tense skin, at the same time that they form channels for the escape of fluid, and the prevention of bags of matter. After the operation, fomentations, or saturnine lotions, were employed.

By the preceding kind of treatment, Mr. Hutchison found the fatal termination of the disease rendered less frequent, and gangrenous mischief wholly prevented. He adds that he never lost a case in the Deal Hospital for the last five years, during which the practice was followed. (See *Med. Chir. Trans.* vol. v. p. 278, &c.)

Instead of several moderate cuts, Mr. Lawrence thinks the most powerful means of arresting the complaint is making one or more long incisions through the inflamed skin and the subjacent adipous and cellular textures, which are the seat of the disease. These incisions, he asserts, are followed very quickly and almost instantaneously by relief and cessation of the pain and tension; and this alleviation of the local suffering, he assures us, is accompanied by a corresponding interruption of the inflammation, whether it be in the stage of effusion, or in the more advanced period of suppuration and sloughing. Mr. Lawrence further maintains, that this treatment is employed to the greatest advantage at the beginning, since it prevents the further extension of inflammation, and the occurrence of suppuration and sloughing. At a more advanced stage, the incisions limit the extent of suppuration and gangrene; and, at a still later time, they afford the readiest outlet for matter and sloughs, and facilitate the commencement and progress of granulation and cicatrisation. (*Med. Chir. Trans.* vol. xiv. p. 67, &c.) In favour of the practice of several, or of one or more free incisions, I have to mention Dr. M'Dowel, of Dublin, Dr. Reese, and Professor Delafield, of New York, who have uniformly obtained the most satisfactory results from it. (See *Amer. Ed.* of this *Dictionary*, art. ERYSIPELAS;) *Rayer* and *Beauchène* at Paris, and a vast number of surgeons in this country.)

To incisions of the kind first suggested and practised by Mr. A. C. Hutchison, and also to the much longer but less numerous ones adopted by Mr. Lawrence, Sir W. Dobson prefers many small punctures, which he repeats mostly twice a day to the number and extent required; and often, in bad cases, three or four times in the twenty-four hours. The quantity of blood and serous fluid discharged from these punctures, although sometimes considerable, he says, need never create any alarm. With this practice he joins the exhibition of camphor mixture, liquor ammon. acet., and tincture of rhubarb. He also employs a lotion, composed of liquor ammoniæ acet., camphorated spirit, and water. (See *Med. Chir. Trans.* vol. xiv. p. 206.)

The great points, on which differences of opinion exist, respecting the treatment by incisions and punctures, are the period when they are indicated, and with respect to incisions, their number and extent. That the practice of incisions with moderation and judgment has been the means of saving many limbs and lives, I consider as fully established as the opposite fact, that immoderate incisions have occasionally accelerated the patient's death. I have heard of instances in which a cut was made from the shoulder down to the hand, or from the trochanter major to the foot, In order, however, to let the reader have a fair view of this part of the subject, I annex some observations of Dr. M'Dowel. "In the treatment of phlegmonoid erysipelas (says he), there is now, I hope, but little difference of opinion, as every practical surgeon must be aware of the importance of early and free incision, in arresting speedily the progress of inflammation, giving great and striking relief in a few minutes, preventing sloughing of the fibrous and other tissues, and purulent infiltration of the cellular membrane. By a timely incision, severe constitutional disturbance will be prevented, or, if it has set in, will be delayed in a few hours. *Puncturing, as a substitute for incision in phlegmonoid erysipelas, is comparatively of little use.* The depth of the incision must be proportioned to the depth to which the inflammation has extended, and the number of incisions proportioned to the extent which the disease has been permitted to attain. In the leg, I have frequently been obliged to make three, four, or five incisions to prevent disorganisation of the soft parts. If the inflammation extends beneath the fascia, this membrane must be divided. Little benefit will be derived from a superficial cut. The edges of the divided membrane retract considerably. Previous to division, the vessels being gorged with blood, the colour of the skin is of a deep red. In a few minutes, after the free division of the inflamed part, we find it nearly restored to its natural appearance. In the great majority of cases, if treated promptly, it will be unnecessary to carry our incision deeper than the cellular membrane." (*M'Dowel* in *Dubl. Journ. of Med. Science*, vol. vi. p. 178.)

A difference of opinion seems to prevail then about the degree of usefulness of punctures in the early stage, in which Dr. M'Dowel would prefer incisions. Yet I have seen three pints of serous fluid discharged from punctures in several instances, and the progress of the disease completely arrested by them. Incisions, no doubt, would also have answered. In the North London Hospital, I frequently practise early and free, yet not enormous incisions. Whatever merit belongs to the practice, and I now acknowledge that it is the means of saving numerous lives and limbs, the honour of this improvement in surgery belongs to Mr. A. Copland Hutchison. Whoever looks over the reports of the consequences of incisions of immoderate length, as detailed in the *Lancet* and other works, cannot fail to be struck with the following facts:— Several patients, treated in this way, instead of being saved, went out of the world in a very sudden manner, sometimes from the shock of an enormous wound on the constitution in its disturbed state; sometimes from profuse hemorrhage. In one or two instances, the cutaneous nerves, as well as large veins and arteries, were not spared, and a partial paralysis ensued.

I know of more than one case, in which the patient died of hemorrhage in a few minutes after an immoderate incision had been made. Dr. M'Dowel, a decided advocate of free incisions, candidly relates the following fact:— "The following case (says he), I witnessed ten years since; and at a more remote period than this, incisions in phlegmonoid erysipelas were constantly practised. A strong and healthy young man had severe phlegmonoid erysipelas of the leg, after an injury of the patellar bursa. The limb, from the foot to half way up the thigh, was enormously swollen, extremely tense, and painful. There was high inflammatory fever. A free incision was made in the leg through the fascia, which retracted widely after its division; the parts were much gorged with blood, and disorganisation of the cellular membrane and aponeurosis had commenced at one part. There was profuse bleeding from the entire almost of the cut surface. The extent of bleeding was not attended to by the person in charge of the case, and in twenty minutes life was nearly extinct. Every plan of stimulation and support was adopted, except transfusion; but death occurred in an hour and a half after the operation." (*M'Dowel in Dubl. Journ. of Med. Science*, vol. vi. p. 179.) This case teaches us, at all events, that the bleeding must not be neglected. I am of opinion, therefore, that incisions of preposterous length are not the most prudent practice; by preposterous, I mean such as require a foot ruler or a yard for their measurement; for nobody is more convinced than I am, that free incisions of less extent are often of the highest service.

Now let me inquire, under what circumstances are punctures and incisions called for? To determine this point, we must remember the principles on which their usefulness depends. First, they are serviceable as affording an outlet to the serosity which fills and distends the cellular tissue, and acts mechanically in bringing on disorganisation of that texture. Secondly, they are useful in occasioning a discharge of blood, whereby the inflammation is checked. Thirdly, in the more advanced stage, incisions are beneficial in affording an outlet for the matter and sloughs. As the cavities of the cellular tissue all communicate, I find that Sir William Dobson's plan of making numerous small and repeated punctures generally answers very well for the discharge of the serosity from that texture, in the early stages of phlegmonous erysipelas. But, if the distension of the cellular tissue increase, notwithstanding this practice, combined with local and general antiphlogistic treatment, then I deem the method of making one or two free incisions in the part advisable to prevent gangrene of that texture. In the stage of suppuration and sloughing of the cellular tissue, no difference of opinion prevails about the necessity of free and depending incisions for the discharge of the matter, and removal of the sloughs. (See *Boyer, Traité des Maladies, Chir.* t. ii. p. 22.; *Dupuytren, Clin. Chir.* t. ii. p. 322.)

Œdematous erysipelas is generally considered to be an unfit case for bleeding and free evacuations, and to require tonic treatment. In short, the right practice, in every example of erysipelas, is to let the remedies be regulated in a great measure by the state of the constitution, the pulse, the strong or reduced condition of the system, the sort of fever accompanying the disorder, the age, temperament of the patient, and the particular stage of the complaint. At first, though antiphlogistic treatment may be the only safe plan, circumstances afterwards change so considerably, that this must be abandoned, and a method, quite the reverse of it, rigorously adopted.

Desault's Parisian Chirurgical Journal, vol. ii. Œuvres Chir. De Desault par Bichat, t. ii. p. 581, &c. *Cullen*'s First Lines of the Practice of Physic, vol. i. *Peart*'s Pract. Obs. on Erysipelas, &c. 1802. *Pearson*'s Principles of Surgery, 1808. Some parts of Hunter's Treatise on thé Blood, Inflammation, &c. *Lassus*, Pathologie Chir. t: i. p. 8, &c. ed. 1809. Traité des Maladies Chir. par M. le *Baron Boyer*, t. ii. p. 6. et seq. *Willan* on Cutaneous Diseases. *A. C. Hutchinson*, in Med. Chir. Trans. vol. v. p. 278, &c. and Practical Obs. in Surgery, ed. 2. *T. Bateman*, A Practical Synopsis of Cutaneous Diseases, p. 125, &c. ed. 3. Dict. des Sciences Méd. vol. xlii. p. 253, &c. *Rayer*, Traité des Mal. de la Peau, t. i. *Butter*'s Remarks on Irritative Fever. Devonport, 1825. Dr. *Duncan*, in Edin. Med. Chir. Trans. vol. i. *Arnott*, in Med. Phys. Journ. vol. lvii. *James*, On Inflammation. *Wells*, in Trans. of a Society for the Improvement of Med. and Surgical Knowledge, vol. i. *W. H. Burrell*, in Edin. Med. Journ. vol. xxiv. *Lawrence*, in Med. Chir. Trans. vol. xiv. *Tweedie*, in Cyclopædia of Practical Med. art. Erysipelas. *Stevenson*, in Edinb. Med. Chir, Trans. vol. i. *Gibson*, Op. cit. vol. ii. *Higginbottom* On Uses of Nitrate of Silver, ed. 2. Dr. *M'Dowel*, in Dubl. Journ. of Medical Science, vol. vi. p. 161. 8vo. 1834.

ERYTHEMA. (From ἐρυθρὸς, red.) A redness of any part. A mere rash or efflorescence, not accompanied by any swelling, vesication, or fever; circumstances which, according to Dr. Bateman, distinguish it from erysipelas. (*Synopsis of Cutaneous Diseases*, p. 119. ed. 3.) Its six varieties are described in the latter work. For the erythema mercuriale, see *Mercury*. The term is often wrongly applied to eruptions, attended with redness, and distinct papular and vesicular elevation, as we see in the instance of mercurial erythema, which Dr. Bateman says should be named *eczema*.

ESCHAR. (From ἐσχαρόω, to form a scab, or crust.) This term is applied to a dry crust, formed by a portion of the solids deprived of life by the action of concentrated heat. When any living part has been burnt by the actual or potential cautery, all that has been submitted to the action of this application, loses its sensibility and vital principle, becomes hard, rough on the surface, and of a black or grey colour, forming what is properly named an *eschar*, a slough, produced by caustics, or actual fire.

ESCHAROTICS. (From ἐσχαρόω, to form a crust over.) Applications, which form an eschar, or deaden the surface on which they are put. By escharotics, however, surgeons commonly understand the milder kinds of caustics, such as the *hydrargyri nitrico-oxydum*, *subacetate of copper*, &c.

EXÆRESIS. (From ἐξαιρέω, to remove.) One of the divisions of surgery adopted by the old surgeons; the term implies the removal of parts.

EXCORIATION. (From *excorio*, to take off the skin.) A separation of the cuticle; a soreness, merely affecting the surface of the skin.

EXFOLIATION. (From *exfolio*, to cast the leaf.) The process by which a dead piece of bone is separated from the living is termed *exfoliation*. One part of a bone is never separated from another by the rotting of the dead part, for what comes away is as firm as it ever was. Before any part of a bone can be thrown off by exfoliation, it must be dead. But, even then, till the process of exfoliation begins, the bone adheres as strongly as ever, and would remain for years, before it could be separated by putrefaction alone. The human bones are composed of two substances, viz. a true animal matter, and an earthy one, the phosphate of lime, which are only mixed with each other. A dead bone acts on the system, in the same manner as any other extraneous body. It stimulates the adjacent living parts, in consequence of which, such a process is begun, as must terminate in its being thrown off. The effects of this stimulus are, first, that the living adjacent bone becomes more vascular; a circumstance, which always takes place, when a part has more to do, than is just sufficient for the support of life. Secondly, that the earth of the living part, when it is in contact with the dead bone, is absorbed; and there the bone becomes softer, and adheres by its animal matter only. As Mr. Wilson has stated, "before any mark of separation is seen on the surface, the living bone surrounding the dead, for the extent of a mere line, has become as soft as if it had been steeped in acid." (*On the Skeleton and Diseases of the Bones*, p. 281. 8vo. Lond. 1820.) Thirdly, that the living animal part is at last absorbed along the surface of contact: this part of the process commences, however, long before the last is finished; and both of them begin at the surface; though, in their course, they do not every where take place in an equal degree at the same time. Fourthly, in proportion to the waste, made by the last part of the process, granulations arise from the living surface, and fill up the intermediate space, so that there is no vacuum. These different stages together constitute ulceration. When any part of a bone is once loose, it is pushed to the surface in the same manner as most other inanimate bodies would be, and this stage is partly mechanical, and partly a continuation of ulceration. A proof of the third stage, above mentioned, may be derived from cases, in which people die, while exfoliation is going on. A small groove, or worm-eaten canal, can then be discovered, which becomes gradually deeper, and follows the irregularities of the living and dead surfaces. After the application of the trepan, a circular piece of bone is frequently thrown off, which is always less than the space from which it came. This, as Mr. Hunter observed, would never be the case, were there not a loss of substance. However, in what manner this loss of substance is produced, has frequently been a question, many pathologists, and amongst them, I believe, is Mr. Gulliver, adopting the belief, that dead bone is not absorbed.

"Although (says Mr. Wilson) in general the absorption takes place in the living bone, it still appears, that, under peculiar circumstances, the absorbing vessels have the power of acting on and removing the substance of dead bone. This happens after the dead part has been separated from the living, and when, from its shape, and the form of the living surrounding bone, it is prevented from obtaining a passage to the surface of the body; as in exfoliations of the cranium, when the inner table of the exfoliated part is broader and wider than the outer table." (*On the Skeleton*, &c. p. 282.) In very hard bones, the colour of the dead exfoliating portion is generally white; but, in softer bones, it is yellow, dark, and sometimes black. (*Wilson*, *op. cit.*)

It was anciently believed, that whenever a bone was denuded, the exposed surface must necessarily exfoliate; and, this being taken for granted, the old surgeons used to put immediately in practice whatever they thought best calculated to bring on an exfoliation as quickly as possible. For this purpose, the actual cautery was usually applied to the part of the bone, which was uncovered; and as, under such treatment, a portion of the bone was of course killed, and then exfoliated, the prejudiced practitioner believed, that he had only accelerated a process, which must of necessity have followed in a more slow and tedious manner.

According to Mr. Hunter, neither caustics nor the actual cautery hasten exfoliation; they only produce death in a part of the bone, which is the first step towards exfoliation; and if they ever hasten exfoliation, when the bone is already dead, it must be by producing inflammation in the adjacent living bone; a change that makes it exert a power of which it was previously incapable.

Exfoliation is not a necessary consequence of a bone being laid bare, and deprived of its periosteum. If the bone be in other respects uninjured, healthy, and enjoy a vigorous circulation of blood through its texture, granulations will be generated on the surface of such bone, and they will cover and firmly adhere to it, without the smallest exfoliation being thrown off; especially in young subjects. But, if caustic, stimulating, or drying applications be made use of, or the bone be left for a considerable time exposed, the circulation in the superficial portion of it will necessarily be disturbed and destroyed, and that part of the surface, through which the circulation ceases to be carried on, will be separated, and cast off, by the process of exfoliation.

If any application to an exfoliating portion of bone be at all efficacious, it must be one which will stop the mortification in the affected bone, and promote the absorption of those particles of phosphate of lime, which form the connection between that which is living and that which is actually dead. And as the bone dies from the same causes as the soft parts mortify, we should at least follow in practice the same principles which we adopt in the latter instance; and though, from the inferior vascularity, and vital power of bones, we cannot expect surgery to have as much control over their affections, as over those of the soft parts, yet, every good will thus be obtained, which it is possible to acquire. Attention to such principles will at least teach us to refrain from making the death of part of a bone more extensive, than it would be, if the cautery, caustics, and strong astringents, were not employed.

The best mode of attempting to prevent an exfoliation from occurring at all in a bone, that has been exposed by a wound, is, to cover the part again, as soon as possible, with the flesh, which has been detached from it. This, as I shall hereafter notice, (see Head, Injuries of,) may generally be practised with advantage, when the scalp has been detached from the cranium, provided the flap still retain even the most limited connection with the rest of the integuments.

When the exposed bone cannot be covered, it should be dressed with the mildest and simplest applications, with plain lint, or lint spread with the unguentum cetaceum.

The dead pieces of bone, when very tedious in exfoliating, when wedged in the substance of the surrounding living bone, and when so situated as to admit of being safely sawn, or cut away, may sometimes be advantageously removed in this manner. (See Caries and Necrosis.) In such operations, Hey's saws may be employed with great convenience; and where these are not applicable, that invented by Machell, and described in Sir. A. Cooper's *Surgical Essays*, or another devised by Graefe, and explained by Schwalb, (*De Serra Orbiculari*, 4to Berol. 1819.) deserve to be recollected.

In speaking of necrosis, I shall have occasion to notice the efficacy of blisters, kept open with the savin cerate, in quickening the process by which dead portions of bone are loosened, as particularly pointed out by the late Mr. Crowther, in his work on the white swelling.

Tenon published three Memoirs on Exfoliation. The two first are inserted at pages 372. and 403. Mém. de l'Acad. des Sciences, 1758; the third at p. 223 of the same work, for 1760. *P. Poissonier*, An recenti vulnere nudatis ossibus exfoliatis? conclusio negans, 4to. Parisii, 1760. Journ. de Méd. par *Le Roux*, t. xxxi. p. 801.; t. xxxii. p. 181.; t. xxxiii. p. 168.; t. xxxvi. p. 537.; t. xxxviii. p. 153.; t. xxxix. p. 132. *Theden*, Neue Bemerkungen, &c. kap. 3. 8vo. Berlin, 1782. Trans. for the Improvement of Med. and Chir. Knowledge, vol. ii. p. 277, &c. *Wiedmann*, "De Necrosi Ossium," Dict. des Sciences Méd. art. Exfoliation. *J. Thomson*'s Lectures on Inflammation, p. 394. 398. *P. Boulay*, Sur l'Exfoliation des Os, 4to. Paris, 1814. *J. Wilson*, on the Structure and Physiology of the Skeleton, and on the Diseases of the Bones, &c. p. 230. &c. 8vo. Lond. 1820. *R. Liston*'s Essay on Caries, &c. in Edin. Med. Surg. Journ. 78.

EXOMPHALOS. (From ἐξ, out of, and ὀμφαλὸς, the navel.) A hernia at or near the navel.

EXOPHTHALMIA. (From ἐξ, out, and ὀμφαλὸς, the eye.) In *exophthalmia*, *ophthalmoptosis*, *ptosis bulbi oculi*, the eyeball is of its natural size, and free from disease: it merely changes its situation, and partly or completely protrudes from the orbit. It is only confusing the subject to consider, as specimens of this disease, the cases in which the globe of the eye is affected with enlargement, and, on that account, projects from the orbit in a preternatural degree, as happens in hydrophthalmia, staphyloma, and cancerous disease. When the globe is pushed entirely out of the orbit, it generally lies upon the temple, or cheek, and vision is totally destroyed. There are instances, however, in which a considerable degree of sight was recovered, notwithstanding the exophthalmia was complete, and had lasted several years. (*Hope. in Phil. Trans. for* 1744. *Richter's Bibl. band* 4. p. 343.)

There are three descriptions of causes, which may occasion exophthalmia:

1. The first and least common is a violent concussion of the head. A man fell from a height of about fifteen or sixteen feet, and pitched upon his head. The right eye was forced out of its socket, and hung over the cheek. The patient was deprived of his senses immediately after the accident, and affected with coma. There was a contusion over the right parietal bone; but no fracture. The eye spontaneously resumed its natural position, a short time after the accident, and, in the course of a month, with the assistance of low diet, and repeated bleeding, the cure was completed. (*Mém de l'Acad. de Chirurgie*, t. 1. p. 198. 4to.) It is alleged, that the eye has been forced out of the orbit in a violent fit of sneezing. But such cases must be very uncommon, and imply a considerable relaxation of those parts, which serve to retain the eye in its socket, or some other predisposing causes, to which attention should be paid in the treatment. (*Richter, Anfangsgr. der Wundarz.* b. iii. p. 407. ed. 1795.)

2. A far more frequent cause of exophthalmia is a thrust in the eye with an instrument, which is narrow enough to pass between the orbit and

the eyeball, so as to push the latter out of its place. A stick, a tobacco-pipe, (*White's Cases in Surgery*, p. 131.) a foil, &c. may cause the accident. Repeated experience proves, that, in such cases, though the optic nerve, and muscles of the eye may be forcibly stretched, the interior parts of the organ seriously injured, and the dislocated eye generally deprived of the faculty of seeing, yet, when the organ is replaced as speedily as possible, it not only sometimes recovers its natural motion, but also its original power of vision. (See *Scultet. Appendix, obs.* 69. *Covillard, obs.* 27. *Borellus, centur.* 3. *obs.* 54. *Rhodius, centur.* 1. *obs.* 84. *White's Cases*, p. 131.) Previously to reducing the eye, we should examine the instrument which was pushed into the orbit; as, when it is brittle, a fragment of it may remain behind in the socket, and require to be extracted by means of the finger or a probe. When the weapon is pointed or hard, it sometimes pierces the bones of the orbit, and enters the brain, nose, or antrum. In the first case, which is often difficult to ascertain immediately, though after a time, it is generally rendered plain enough by the symptoms induced, the consequences are mostly fatal. In the two other cases, although the danger is not pressing, the surgeon should be very attentive, in the event of suppuration, to procure and maintain a ready outlet for the matter.

There is generally little difficulty in replacing the eye. Frequently it returns of itself into its natural situation, as soon as any trivial obstacles to its reduction are removed; and in other instances, it easily admits of being put into its proper place with the hand. The indication, says Richter, is always accomplished with more facility, the sooner it is attempted. When the protrusion has existed several days, and the eye and other parts in the orbit are already inflamed, Richter recommends us to endeavour to diminish the inflammation by general antiphlogistic means, and external emollient applications, before we try to replace the eye, and the reduction of this organ is afterwards to be effected in a gradual manner. When the optic nerve, and one or more of the muscles of the eye are torn, no hope can be entertained, that the eyesight and motion of the organ will ever be regained. But this degree of injury, as Richter observes, cannot always be immediately detected, because the optic nerve and muscles are concealed by the conjunctiva; and, if the nature of the case were known, still it would be advisable to replace the eyeball.

When the instrument, with which the eye has been pushed out of its socket, is blunt and thick, like a finger, a stick, a foil, &c. the eyeball itself always sustains a violent contusion, which brings on vehement inflammation, and lessens or destroys all hope that, after the reduction, the eyesight will be restored. Sometimes, an extravasation of blood in the orbit occurs, the iris is lacerated, the cornea burst, and a part of the humours of the eye discharged. Although, under such circumstances, it is scarcely to be expected that the eyesight can be recovered, yet, it is proper to reduce the eye, because, should the organ be destroyed by suppuration, or the loss of its humours the deformity may be obviated by an artificial eye, which is not the case, when the eye has been cut away. It is also to be considered, that the mischief often seems to be worse than it really is, and the eyesight is sometimes regained, contrary to all expectation.

After the reduction of the eye, the first care of the surgeon should be to prevent and diminish inflammation. In some cases, the inflammation is slight; while, in others, especially when the eyeball has been severely struck, it is extremely violent. All the usual antiphlogistic means, both general and topical, are to be employed, and, of the atter, Richter says, astringents are the best, as the inflammation arises from the contusion and stretching which the parts have suffered. The possible consequences of inflammation, such as suppuration, opacity of the cornea, &c. are to be treated according to the rules laid down in other parts of this dictionary. (See CORNEA, OPACITY OF; HYPOPIUM; OPHTHALMY.) In general, the sight is restored in proportion as the inflammation is diminished. Should this not happen, after the ophthalmy has been entirely removed, the surgeon must try what effect such remedies, as stimulate the nerves, will have upon the optic nerve. An account of the most eligible medicines for this purpose will be found in the article AMAUROSIS.

3. The third cause of exophthalmia is a preternatural tumour in the orbit, or neighbouring parts. The swelling, as it enlarges, gradually pushes the eyeball out of its socket. The tumours, which may be formed in the orbit, are of several kinds. The principal, however, are encysted swellings, which contain either fat, an aqueous fluid, a pappy substance, or a thick matter. Sometimes, the cellular tissue in the orbit is affected with induration and swelling, so as to force the eye partly or completely out of this cavity.

Adipous swellings occupy the interspace of the recti muscles, emerge between the globe and the orbitar circumference, and have an oblong figure. When the conjunctiva is freely divided, the fatty mass is easily drawn forwards with a hook, and dissected out. (*Travers, in Synopsis of Dis. of the Eye*, p. 225.)

An abscess in the orbit may cause a protrusion of the eyeball. (*Pellier.*) Exostoses may have the same effect. Sir Astley Cooper has related one case, which proved fatal, in consequence of the exostosis making its way to the brain through the orbitar process of the os frontis. (*Surgical Essays*, part i. p. 157.) Mr. Guthrie has seen two instances: in one, the disease attained the size of a large marble, and then became stationary; in the other, it was much larger, and a portion of it had been ineffectually removed by means of a hot iron, which increased the inconvenience, without giving any relief. Hence, if an operation were deemed advisable, Mr. Guthrie would prefer the cautious use of a small chisel or saw. (*Operative Surgery of the Eye*, p. 154.) This author is at the same time aware of the case, in which M. Brossaut brought about the exfoliation of a considerable part of an exostosis of the os planum and internal angular process with caustic, so that the eye returned into its place, and the cure was completed. (*Mém. de l'Acad. de Chir.* t. v. p. 171. 4to.) In the records of surgery may be found examples, in which the displacement of the eye was produced by a tumour, that grew out of the frontal sinus. (See *Langen-*

beck's Neue Bibl. b. ii. p. 247.) In some cases, in consequence of suppuration in the antrum, the lower part of the orbit is raised, and the eye forced out of its place. Fungous diseases of the antrum may occasion the same mischief. (See *Parisian Chir. Journal*, vol. i. p. 104, &c.)

Schmidt records two cases of exophthalmia, produced by an hydatid of the lachrymal gland. One had a fatal termination; but, in the other, a puncture gave vent to an ounce of clear fluid, and cured the protrusion of the eye; but, the eyesight was lost. (*Ueber die Krankheiten des Thränenorgans*, p. 54.) Farther particulars of the latter case may be seen in Mr. Guthrie's work, p. 157.)

Not long ago, Langenbeck extracted from the sinus frontalis of a girl, a large hydatid, which had forced the outer table considerably forwards, and depressed the orbitar process of the os frontis so far, that the eyeball was propelled as low as the extremity of the nose. After the front of the sinus had been perforated, and the hydatid removed, there was a cavity left two inches and a half in depth. (*Neue Bibl.* b. ii. p. 247. Hanover, 1819.) My friend Mr. Lawrence mentioned to me a remarkable case, which presented itself at the London Eye Infirmary: it was an exophthalmia, which arose from a collection of hydatids in the orbit, and was cured by making an incision, and afterwards promoting their discharge. In all these examples, the eyeball is displaced from the orbit gradually, and vision is at length impeded. Instances, however, are on record, where the sight was never lost, though the eye was protruded for years. (See *Richter's Chirurg. Bibliothek*, band iv. stück ii. p. 243. *White's Cases in Surgery*, p. 135.) In one instance, the sight was not at all lessened, and the iris retained its natural mobility. (*Langenbeck, Neue Bibl.* b. ii. p. 245.)

Experience proves, also, that after the reduction, the motion of the eye, and power of seeing may be regained, in cases, where the eye has been gradually pushed out of the orbit, and been displaced a considerable time, even as long as several years, during all which period vision was lost. (*Acrell, Brocklesby. in Med. Obs. and Inquiries*, vol. iv. p. 371.) Langenbeck relates a case of exophthalmia from a steatoma in the orbit, where, though vision was entirely prevented during the displacement, the pupil was of its regular shape, and the iris capable of motion: after the extirpation of the tumour, the eyesight became so good, that the patient could discern the smallest objects. (*Neue Bibl.* b. ii. p. 240.) In order to reduce the eye into its natural position, it is necessary to remove the cause by which its protrusion is occasioned. Suppuration and fungous tumours in the antrum must be treated according to directions laid down in the article Antrum. The induration and swelling of the cellular substance in the orbit may be sometimes dispersed by means of mercury. (*Louis, Sur Plusieurs Maladies du Globe de l'Œil, in Mém. de l'Acad. Royale de Chirurgie*, t. xiii. éd. 12mo.) When such treatment fails, we are recommended to extirpate the eye. (*Richter, Anfangsgr. der Wundarzn*, b. iii. p. 413.) Exostoses, situated in the anterior part of the orbit, may sometimes be removed. The continental surgeons generally advise us to expose the tumour by an incision, and to apply caustic or the actual cautery to it, in order to kill the protuberant part of the bone, and make it exfoliate. In this country, most practitioners would prefer the employment of cutting instruments for removing such exostoses. When, however, the tumour lies deeply in the orbit, if it cannot be got at, and it should resist the effect of mercurial medicines and mezereon, we are directed to extirpate the eye. (*Richter, Op. et loco cit.*) Abscesses in the orbit ought to be opened, and after this has been done, the eye generally returns into its proper position. (*Pellier.*) When encysted tumours in the orbit admit of being extirpated in the customary manner, the plan should be adopted; but, when this cannot be done, Richter's advice may be followed, which is to open them, press out the contained matter, and afterwards extract the cyst. Considerable difficulty, however, frequently attends every effort to remove the whole cyst, and unless this be done, a permanent cicatrisation cannot be expected. (See *Travers's Synopsis*, p. 225. See Tumours, Encysted.)

On account of the vicinity of the brain, and the communication between the parts within the orbit, and the dura mater, the extirpation of tumours from that cavity is not exempt from risk of fatal consequences, as two cases, published by Langenbeck, fully prove. (*Neue Bibl.* b. ii. p. 241—244.) I remember a young lady who was referred to Mr. Lawrence and myself, by Mr. Maul of Southampton, for advice respecting a tumour, occupying the inner and upper portion of the orbit, and attended with a degree of exophthalmia, constant exacerbation at the period of the menses, and occasionally double vision. (See Diplopia.) We refrained from advising any immediate attempt at extirpation, the swelling being so firm and immoveable, that the disease was suspected to be partly of a bony nature. However, on seeing this case, about a fortnight afterwards, I was surprised to find the tumour not more than half its former size, and all the firm and (what was conceived to be) bony induration below the superciliary ridge of the os frontis gone, as well as the exophthalmia, and derangement of vision. Some sharp bony irregularities, however, could now be most plainly felt, projecting in front of the diminished swelling.

A memorable case of exophthalmia is related by Mr. Travers: the globe of the eye appears to have been gradually forced upwards and outwards, and to have had its motions considerably impeded, in consequence of the orbit being partly occupied by two swellings, which were of the nature of aneurism by anastomosis. (See Aneurism.) The swellings could not have been removed, without at the same time extirpating the eye. Mr. Travers was therefore induced to try, whether applying a ligature to the carotid artery would have the effect of checking and curing the disease; an expectation which was warranted by analagous instances, in which the growth of swellings, and their dispersion, are brought about by lessening the quantity of blood determined to them. The experiment completely succeeded; the swellings in the vicinity of the eye subsided; the patient was freed from several grievous complaints, to which she had been previously subject; and, amongst other benefits, a cure of the exophthalmia was one result, which most interests us in the present place. The case is also highly important on other accounts, and, more particularly as confirming the fact, that the carotid artery may be tied, without any dangerous effects on the brain, and as proving, that, in cases of aneurism, the surgeon should not be afraid of proceeding to such an operation. (See *Méd. Chir. Trans.* vol. ii. art. 1.) The judgment and decision, with which Mr. Travers acted in this case, appear to me highly meritorious.

The carotid artery was also tied by Mr. Dalrymple, of Norwich, in a case very similar to the preceding, and with equal success. (See *Méd. Chir. Trans.* vol. vi. p. 111, &c.)

Mr. Guthrie has seen an exophthalmia on each side, the result of an aneurism of each ophthalmic artery, and other disease in the orbits. (*Operative Surgery of the Eye*, p. 158.)

When the causes of exophthalmia have been removed, the eye must be put into its natural situation. If the organ has been long displaced, the surgeon often finds the fulfilment of this indication attended with difficulty. Indeed, he is frequently obliged to employ methodical bandages for the purpose of promoting the gradual return of the eye into the orbit. Yet, even in such cases, the eyesight is often regained: but, if this should not happen spontaneously, stimulants and tonics are to be tried.

Fab. Hildan. centur. vi. obs. 1. Vander Wiel, centur. ii. obs. 9. Paw. Obs. Anat. 23. Tulpius, lib. i. cap. 28. *Hope*, in Phil. Trans. for 1744. *Louis*, Sur plusieures Maladies du Globe de l'Œil, &c. in Mém. de l'Acad. de Chirurgie, t. xiii. in 12mo. *Brocklesby*, in Medical Obs. and Inquiries, vol. iv. p. 371. *White*'s Cases in Surgery, p. 131 — 135, &c. *Warner*'s Cases in Surgery, p. 108. edit. 3. *Lassus*, Pathologie Chir. t. ii. p. 144. édit. 2. *Richerand*, Nosogr. Chir. t. ii. p. 117. édit. 2. Méd. Chir. Trans. vol. ii. art. 1.; vol. iv. p. 316,; and vol. vi. p. 111, &c. *Richter*'s Anfangsgr. der Wundarzn, b. iii. p. 406, &c. Gött. 1795. *Langenbeck* Neue Bibl. b. ii. *B. Travers*, Synopsis of the Diseases of the Eye, p. 225, &c. Lond. 1820. Dr. *Monteath*, in *Weller*'s Manual, vol. i. p. 195. *Petitbeau*, in Journ. de Méd. par Corvisart, t. xiv. *G. J. Guthrie*, Operative Surgery of the Eye, p. 145, &c. 8vo. Lond. 1823.

EXOSTOSIS. (from ἐξ, out, and ὀστέον, a bone.) An exostosis is a tumour formed by an exuberant growth of bony matter on the surface of a bone, or it is formed by the more or less considerable enlargement of a part, or the whole, of a bone. (*Boyer, Mal. Chir.* t. iii. p. 541.)

In general, however, it is only when the enlargement is partial, that it is termed an exostosis. As Mr. Mayo has pointed out, some hypertrophies of bone are connected with a salutary principle; while others constitute curable, or incurable diseases. The arm of a blacksmith acquires, through daily exertion, additional muscular force, weight, and size; the bones in it enlarge; their crust becomes harder, and of a more compact grain; and the lines upon the surface, which give attachment to tendons, become rough and prominent ridges. This is health. When Mr. Cheshire's apparatus for supporting the spine is worn, the pressure on the lower jaw generally causes this bone to enlarge, and to throw out a bony swelling, where the chin strap is applied. This tumour is an exostosis, yet it evidently results from the salutary principle, which strengthens a part in proportion to the exertion imposed upon it. (See *Mayo's Outlines of Human Pathology*, p. 11.)

While the growth of the whole body is proceeding rapidly, abnormal swellings of parts of bones are common, especially of the clavicle, sternum, or ribs. These are exostoses, which require no treatment, as they generally subside of themselves in the course of a year or two. Exostoses are still more common at the period, when the body has recently attained its full growth. But the disease is not limited to the early, nor to the middle periods of life. (*Ib.*)

One division of exostoses is into *true* and *false*; the former being of a truly osseous consistence, the others being more or less hollow, spongy expansions of the bones, sometimes containing a quantity of cartilaginous, fibrous, medullary, or fungous matter within the shell of the disease. Periostoses, or mere thickenings of the periosteum, are also sometimes classed amongst *false* exostoses. (*Dict. des Sciences Méd.* t. xiv. p. 218.) According to Sir Astley Cooper, exostoses have two different seats: by *periosteal* exostosis he means, an osseous deposition seated between the external surface of the bone, and the internal surface of the periosteum, and firmly adherent to both; by *medullary* exostosis, he signifies a similar formation, originating in the medullary membrane, and cancellated structure of a bone. The same experienced surgeon makes two other general divisions of exostoses into the *cartilaginous* and *fungous*, the first being "preceded by the formation of cartilage, which forms the nidus for the ossific deposit," while the second is a tumour softer than cartilage, yet firmer than fungus, in other parts of the body, containing spiculæ of bone, being of a malignant nature, and depending "upon a peculiar state of constitution and action of vessels." It is a disease similar to "fungus hæmatodes, but somewhat modified by the structure of the part in which it originates." (*Surgical Essays*, part i. p. 155.)

If a true exostosis be immersed in diluted muriatic acid, so as to separate the earthy part of it, the tumour will yet retain its form, and present the same kind of fibro-cartilaginous matrix, which exists in healthy bone. (*Ib.*)

Exostoses differ in *size*. Those of the cranium are generally small and circumscribed, yet exceptions occur; for Sir Everard Home removed a very large tumour, which had a bony base, and was situated on the head. (*Sir A. Cooper, Surgical Essays*, part i. p. 156.) The largest *true* exostoses are formed upon the long bones. In the history of surgery may be found numerous cases of enormous exostoses; but nearly all of them of the species termed *false*, and many of them were situated on the jaw, the clavicle, or the extremities of the long bones. Observations of this kind are abundant in l'Histoire de l'Acad. des Sciences; les Mém. de l'Acad. de Chir.; the Sepulchretum Anatomicum; the writings of Morgagni, &c. (*Dict. des Sciences Méd.* t. xiv. p. 219.)

The bones, most frequently affected with exostosis, are those of the cranium, the lower jaw, sternum, humerus, radius, ulna, bones of the carpus, and particularly the femur and tibia. There is, however, no bone of the body, which may not become the seat of this disease. It is not uncommon to find all the bones of the cranium affected with exostosis, and the ossa parietalia sometimes an inch thick.

The exostosis, which forms between the outer table of the skull and the pericranium, is of extremely hard consistence, and generally attended with little pain, while the *fungous* exostosis, springing from the diploe of the skull, is less firm, more vascular, and of a malignant nature, making its way through the inner table, and occasioning disease of the dura mater, and fatal effects on the brain. (See *Sir A. Cooper's Surgical Essays*, part i. p. 156.)

Sometimes the tumour is confined to a small part of the affected bone, composing a mass superadded to its surface, and of various shapes. Sometimes it rises insensibly, having no very distinct limits, and resembling a more or less regular portion of a sphere. In some instances, its figure is styloid, and it projects in a greater or less degree. On other occasions, its base is rendered distinct by a pedicle, or contraction, which varies in breadth and length in different cases. In particular instances, the exostosis, though limited to the surface of a bone, occupies the whole extent of it. Thus, the whole external surface of one of the bones of the skull has been found occupied by an exostosis, while the inner table was in the natural state. The whole circumference of the femur sometimes acquires an enormous size, at the same time that its medullary surface continues entirely unchanged. These are the *periosteal* exostoses of Sir Astley Cooper. In other examples, on the contrary, the two surfaces and the whole thickness of the bone are deformed by an augmentation of bulk; and when this happens in a cylindrical bone, the medullary cavity is more or less reduced, or even totally obliterated. In a few extremely uncommon cases, the substance of a bone acquires great solidity, and a hardness compared to that of ivory, without any material increase of bulk. An exostosis rarely occupies the whole extent and thickness of a bone; but when this happens in a cylindrical bone, the articular surfaces generally remain in their natural state.

Common situations of exostoses are the upper part of the humerus and tibia, and the lower part of the femur, especially near the insertion of the tendon of the adductor magnus. (*Sir A. Cooper*) In the long bones, exostoses are generally narrow, and of greater height, than thickness; sometimes largest at their base; sometimes the reverse. In the flat bones, they are usually broad, but they form flat discs, connected to such bones by means of short narrow pedicles. In the round bones, they are rounded and nodular. To these laws, as Mr. Mayo observes, there are many exceptions. (*Outlines of Human Pathology*, p. 12.)

The *structure* and *consistence* of exostoses present great differences. Sometimes, especially when the tumour is not very large, and situated on the surface of a cylindrical bone, one may trace with the eye the diverging of the osseous fibres, in the interspaces of which we might say, that there is deposited a new bony substance, the organization of which is less distinct. Sometimes the tumour is entirely cellular, and formed of a few broad laminæ, intercepting extensive spaces, which are filled with matter different from the medulla, and of various quality. This case is denominated the *laminated exostosis*. Sometimes the enlarged portion of bone makes a sort of hollow sphere, with thick hard walls, and the cavity is filled with a firm indolent fibrous substance. One form of exostosis Sir Astley Cooper has named the *cartilaginous exostosis of the medullary membrane*. "In this case, the shell of the bone becomes extremely expanded, or rather the original shell is absorbed, and a new one deposited; and within this ossified cavity thus produced, a very large mass of cartilage is formed, elastic, firm, and fibrous." It is not malignant, but often ends in a very extensive disease. (*Surgical Essays*, part i. p. 173.)

In other instances, the tumour is perfectly solid, exceeding in consistence that of the hardest bones, and equalling that of ivory. The ivory exostosis is thought by Mr. Mayo to be occasionally malignant; and he mentions, that Mr. Stanley, has a preparation of one, which is combined with medullary sarcoma. (*Human Pathology*, p. 14.) I suspect, that this must have been an accidental concurrence with the more solid exostosis. Here the surface is sometimes smooth, and like that of the bone in its natural state; sometimes irregular, full of little projections, and in some degree stalactical. It is uncommon to find a large portion of an exostosis converted into a pultaceous substance; but it is not at all unfrequent to see this substance composing part of the tumour. Lastly, it often happens, that the same exostosis presents an assemblage of the ivory substance, and of the cellular laminated substance, the cavities of which are partly filled with a pultaceous matter, and partly with a sort of gelatinous substance.

An extraordinary instance of what is sometimes called *spiculated* exostosis, is related. Spiculæ, or ramifications of bone, are represented as projecting from the various bones, and causing anchylosis of every joint, with the exception of the wrists and knees. One branch is seen to extend from the coccyx to the femur. Another case is also reported by Freke, where the exostoses are compared to the branching of coral, the bony formations projecting from the cervical and other vertebræ, and joining others from the ribs, so as to make a kind of bodice on the back. (See *Phil. Trans.* vol. 41; and *Wickham on Diseases of Joints*, p. 8.)

When an exostosis is not very large, it hardly affects the surrounding soft parts; but when it has made considerable progress, the muscles become stretched and emaciated, the cellular tissue is thickened, and, its layers being adherent together, a kind of confusion is produced amongst all the adjacent parts. Exostoses not of considerable size may, however, seriously interrupt the functions of certain organs. The action of the flexor muscles of the leg has been known to be obstructed by an exostosis in the vicinity of the knee. A similar tumour, arising near the symphysis pubis, need not be very large to impede considerably the functions of the urethra, as experience has proved. An exostosis in the orbit has been known to displace the eye and destroy vision. Lastly, exostoses, when situated near certain important organs, and of large size, may affect with different degrees of gravity the functions of these parts, as the brain, the lungs, &c. (See *Boyer, Mal. Chir.* t. iii. p. 541—544.)

Sir Astley Cooper has related a case, in which the eyes were pushed out of their sockets by two exostoses, which grew from the antra, and one of which destroyed the patient by making its way to the brain through the orbitar process of the os frontis. (*Surgical Essays*, part i. p. 157.) In one instance, reported by the same author, an exostosis from the sixth or seventh cervical vertebra abolished the pulse at the wrist, by pressing upon the subclavian artery. (P. 159.) In another, a *cartilaginous* exostosis of the medullary membrane of the lower jaw extended so far back, that it pressed the epiglottis down upon the rima glottidis, and caused such difficulty of respiration, and so much irritation, that the patient was destroyed. (P.175.)

Some particulars of an exostosis, are recorded, which projected from the posterior surface of the symphysis pubis into the bladder. The case, while the patient lived, might have been mistaken for an adherent calculus. (See *J. Cloquet, Pathol. Chir.* p. 130. 4to. Paris, 1831.) Dupuytren had a case, in which an exostosis of the femur obliterated the femoral artery. (See *Clin. Chir.*) A patient had an exostosis of the first rib, which threw forward the subclavian artery, so as to give the appearance of a subclavian aneurism. (See *Mayo's Outlines of Human Pathology*, p. 12.) I find a case referred to, in which an exostosis of the anterior surface of the sacrum pushed the rectum so far forwards, as to render the introduction of a small bougie into that bowel very difficult. (*B. Bell on Diseases of Bones*, p. 115, 12mo. Edinb. 1828.) Frequently exostoses interrupt the free movement of a joint; thus, Mr. H. Lyford removed one, which was of the size and shape of the little finger, and situated just on the inside of the capsular ligament of the shoulder joint, on the front and inner part of the humerus. The direction of the point was upward and inward toward the clavicle and sternum, and the motion of the humerus inwards was interfered with. (See *W. J. Wickham on Diseases of the Joints*, p. 7.)

Venereal exostoses, or nodes, are observed to arise chiefly on compact bones, and such of these as are superficially covered with soft parts, as, for instance, the bones of the cranium, and the front surface of the tibia.

The causes of exostoses are obscure. They may be induced, however, by a blow, or pressure. Most writers impute the disease to internal causes, such as scrofula and lues venerea. That the latter affection is the cause of nodes, which are certainly a species of exostosis, no one will deny: but, that scrofula is concerned in producing exostoses is more doubtful. Sometimes I have suspected, that some of those bony swellings, which are so common in children during the rapid growth of the body, are connected with a scrofulous constitution. At all events, I have noticed them with great frequency in children of this description, though it might only be an accidental coincidence.

Hydatids are occasionally found within exostoses, in which circumstance the former are supposed to be the cause of the enlargement of the bone. A remarkable specimen of such a disease in the tibia is mentioned by Sir Astley Cooper. (*Surgical Essays*, part i. p. 163.) He refers also to a humerus, in the museum of St. Thomas's Hospital, where the shell of the bone is considerably expanded, the periosteum over it thickened, and in the seat of the cancellated structure, are several hydatids, supposed to have been the cause of the enlargement of the exterior surface of the bone, as well as of the increase of its cavity. (*Vol.* cit. p. 161.)

A most interesting case of a bony tumour on the forehead, containing hydatids, was published by Mr. R Keate. (*Med. Chir. Trans.* vol. x. p. 278.)

The disposition to the formation of ossific tumours may prevail throughout the system, and display itself in other textures, besides the bones. Thus, Mr. Mayo refers to a specimen of ossification of the lungs, taken from a patient, who died of pulmonary disease after amputation of the leg for ivory exostosis. (See *Outlines of Human Pathology*, p. 14.) The alliance, between the ossification of ligament, muscle, tendon, and exostoses, is well illustrated in Jeff's skeleton in the Hunterian Museum. Some of the ossifications form exostoses, while others pass from one part of the skeleton to another. The first prevail, especially in places, where muscles are inserted. The second have generally followed the course of the larger muscles, and may be seen on the right side, joining the clavicle and acromion to the humerus, in the situation of the supra spinatus, and passing from the lower angle of the scapula to the humerus in the course of the teres major and latissimus dorsi. On the back, more extensive ossifications appear, which affix the scapulæ to the sacrum and ilium, and to the spines of the lumbar and dorsal vertebræ. From the pelvis, ossifications extend in the direction of the glutæus maximus, biceps, and triceps. Ossifications of the tendinous and ligamentous parts are still more common, producing anchylosis of the vertebræ, left elbow, tibia and fibula, and of the bones of the tarsus to one another. (See *Museum Catalogue.*)

The readiness, with which bony tumours form in some persons, renders it probable, that constitutional causes have great influence. Thus, such a blow as, in the generality of persons, would hardly excite notice, will, in others, bring on swellings of the bone which is struck. Sir Astley Cooper adverts to a young friend of his, in whom an exostosis, which was undoubtedly caused by a blow, is growing on the metacarpal bone of the little finger. (Loc. *cit.*) Mr. Abernethy used to mention in his Lectures, a boy, from Cornwall, who was so excessively afflicted with an apparent predisposition to exostoses, or an exuberant deposition of bony matter, that a very trifling blow would occasion a bony swelling on any bone of his body. His ligamentum nuchæ was ossified, and prevented the motion of his neck; the margins of his axillæ were also ossified, so that he was, as it were, completely pinioned. Besides all this, the subject in question had numerous other exostoses on various parts of his body. Mr. Abernethy gave, in this case, muriatic and acetic acids, with the view of dissolving the lime, which it was conceived might be too abundant in the system; but, even if this theory had been correct, and the acids capable of the chemical action intended, after passing into the circulation, how could they be expected to dissolve only the redundant depositions of phosphate of lime, and at the same time leave the skeleton itself undissolved?

When an exostosis depends upon lues venerea, it is almost always preceded by an acute pain, which in the beginning extends to nearly the whole of the affected bone, but afterwards becomes fixed to the point where the exostosis forms, and it is most severe in the night-time. When an exostosis is caused by scrofula, says Boyer, the pain is duller, or rather it is quite inconsiderable. It is the same with the exostosis which succeeds a blow, or contusion, without any manifest general cause. In the latter example, the pain, immediately excited by the accident, subsides in a few days, and the swelling occurs so slowly, that no notice is taken of it till it has attained some magnitude. (*Mal. Chir.* t. iii. p. 545.)

An exostosis constantly feels hard; but its size is various, and it may be indolent, or painful. By these signs, and its firm adhesion to the bones, it may be always distinguished from other tumours. Some exostoses cannot be ascertained before death.

Such was the case in which the parietal bone was found, after death, to be three times thicker than natural. Such also was the example, related in the memoirs of the Academy at Dijon, in which a person died from an exostosis on the internal side of the os pubis, the tumour having prevented the discharge of the urine, and the introduction of a catheter, by its pressure on the neck of the bladder.

Exostoses may be either *acute*, or *chronic*, in their progress. In the first case, which, according to Boyer, happens most commonly in the *cellular* exostosis, described by authors under the name of *laminated*, the appearance and formation of the tumour are quick; the swelling rapidly acquires a considerable size; and, it is always preceded by, and accompanied with, continual violent pain, which the external and internal use of opium has little effect upon, and the intensity of which is not increased by pressure. The pain is sometimes so severe that it occasions a good deal of symptomatic fever. Boyer, who seems not to be aware of the origin of what he terms the *cellular*, and what Sir Astley Cooper has named *fungous exostosis*, from the medullary membrane, finds difficulty in accounting for the rapid growth and great sensibility of the tumour, considering the natural density of the bones, and the little energy of their vital properties.

In the hardest kinds of exostosis, the tumour is preceded by no pain, or, if any, it is very slight; the tumour grows slowly; and although it sometimes attains a considerable size, its increase is attended with no particular sensibility, and no disturbance of the animal economy. (*Boyer, Op.* cit. t. iii. p. 546.)

Our ignorance of the pathology of exostoses, particularly their causes, accounts for the imperfection of our treatment of them. With the exception of the venereal exostosis or node, there is no species of this affection, for which it can be said that we have any medicine of efficacy.

Boyer regards some exostoses as a perfectly inorganic mass of lime, and, consequently, he entertains no idea that the absorbent vessels can possibly take away the particles of the tumour, just as the secerning arteries have laid them down.

He acknowledges, indeed, that he has seen a venereal exostosis of the humerus, as well as a few other bony swellings, subside; but he represents the event as extremely rare; and he advances it as a principle, that the resolution of exostoses hardly ever happens, and that the greater part of the examples, recorded in proof of the occurrence, were nothing more than periostoses. (P. 547.)

However, a young woman was in the Middlesex Hospital with an exostosis of the humerus. It was sawn off, but grew again. A rubefacient plaster was applied, an abscess followed, and the new bone was absorbed. (See *Mayo's Human Pathology*, p. 13.) When abscesses form, exostoses are very subject to be attacked with caries, or necrosis.

When an exostosis is hard, chronic, and free from pain and alteration of the structure of the bone, it is more common for it to cease to enlarge and remain stationary during life, without producing inconvenience, provided it be so situated as not to impede the functions of any vital organ.

But, in the *cellular* exostosis of Boyer, which I take to be the same disease as the *fungous* exostosis of the medullary membrane of Sir Astley Cooper, the acute and rapid progress of the disease indicates a deeper and more serious alteration of the texture of the bone. A part of the tumour usually consists of a pultaceous, or gelatinous matter, and the rest, still endued with its natural organization, though altered by the disease, soon presents one or several cavities, in which there is suppuration. At the same time, the external soft parts, being excessively and rapidly distended, inflame, ulcerate, and leave exposed a more or less extensive portion of the tumour, the disease of which has in many cases been very wrongly supposed to be caries. It is not, observes Boyer, that the part of the swelling denuded by ulceration is not sometimes affected with caries; but, then it exists as a complication of the original disease, and as a particularity, by no means the result of the ulceration of the soft parts, and of the exposure of the diseased bone to the contact of the air. When the soft parts are thus ulcerated, the opening contracts to a certain point, and becomes fistulous. The suppuration is always of bad quality, and in a quantity proportioned to the size of the cavity of the abscess and the strength of the patient. The fever, which commences at an early period of the disorder, assumes a slow type, and its continuance, together with the copiousness of the ichorous discharge, the irritation, &c. may bring on the patient's dissolution.

The following are the symptoms of what Sir Astley Cooper denominates the *fungous exostosis of the medullary membrane.* The disease begins with a general enlargement of the affected part of the limb, extending a considerable way around the seat of the exostosis itself. This form of the complaint mostly occurs in young persons, though Sir Astley Cooper has seen it in an individual fifty years old. "Its increase proceeds very gradually; and even when it has acquired considerable magnitude, although it produces some diminution of motion in the limb, it does not occasion pain, nor prevent the patient from using it. When any pain does arise, it is of an obtuse kind, only being acute in the event of a nerve being stretched by the tumour. Thus an exostosis of the thigh-bone sometimes causes great agony, by pressing on the sciatic nerve. Paleness, debility, and irregularity of the bowels, are observed to attend the early stage of the disease; and afterwards the complexion becomes sallow. In the mean time, the diseased part of the limb attains an enormous size; but the skin retains its natural colour. At many points, the swelling feels hard; at others, it is so elastic as to cause the presence of fluid to be suspected; but, if an opening be made, only blood is discharged. The surface of the tumour next becomes tuberculated, and the prominences tender, and their surface is often slightly inflamed. The rest is now broken, the appetite impaired, and the bowels extremely irregular. At length, the tubercles ulcerate; the skin secretes pus; but, when the swelling itself is exposed, it discharges a bloody-coloured serum. A fungus then forms, which sometimes bleeds profusely, and, after it has risen very high, sloughing occurs, and considerable portions of the swelling are thrown off. But, although the swelling may be lessened by this process, Sir A. Cooper has never known the disease cured by it; and, in the end, the patient is destroyed by the effects of the repeated bleeding, immense discharge, and constitutional irritation." In this disease, as in common fungus hæmatodes, tumours of a similar nature are often formed in other parts of the body, and, after the amputation of the affected bone, frequently make their appearance in organs of the greatest importance to life. The swelling is described as originating from the medullary membrane, and as removing the muscles to the distance of three inches, or more, from the bone, so that they represent a thin layer spread over the tumour. The blood-vessels and large nerves are also similarly displaced. The tuberculated appearance of the skin, which is itself sound, is caused by projecting small masses on the surface of the tumour. Under the muscles is the periosteum, pushed to a considerable distance from the bone. A part of the swelling itself is yellow, like fat; another portion resembles brain; and a third is composed of coagulated blood with interstices filled with serum. In some parts, the white substance is found nearly as firm as cartilage; but, in general, it presents a more spongy appearance; and is interspersed with spiculæ of bone. The shell of the bone itself is in part absorbed; in some places it is only thinner than usual; while in others it is immensely expanded, so as to form a case like wire-work over the tumour. The fungous granulations, proceeding from the medullary membrane itself, are exceedingly vascular, and often shoot from the cavity of the bone beyond the level of the integuments. (*Sir A. Cooper, Surgical Essays*, part i. p. 165—168.)

One termination of oxostosis, not sufficiently noticed by writers, but which has been observed, especially in the hard and stalactical exostosis, is that by necrosis. Tumours of this description, after acquiring a large size, have been attacked by necrosis, separated from the bone which served them as a base, and been surrounded with a reproduction in every respect similar to that with which nature surrounds sequestra formed under any other circumstances. This termination is undoubtedly the most favourable of all, because nature proceeds in it slowly, without any violent disturbance; but, unfortunately, it is the least common. Art can imitate it; but her means are very inferior to those of nature. (*Boyer, Mal. Chir.* t. iii. p. 547—550.) A few years ago, a most interesting case of an enormous exostosis of the upper maxillary bone, which followed the preceding course, was under my notice. It was believed at first to be a malignant tumour of the antrum; but the bony formation after exciting abscesses, was attacked with necrosis, and was ultimately thrown off by exfoliation. On this case, I had a consultation with my friend, Mr. Lawrence.

The hardest exostosis, which has grown slowly, and without causing severe pain, is the least dangerous of all. After the disease has attained a certain size, it may become stationary, and continue in this state, without inconvenience, during life. This is most frequently observed in the *ivory* exostosis; and I join Boyer and others, in not considering this case as at all disposed to malignancy. Without having precisely this extreme hardness, however, some exostoses, which are tolerably solid, and in which the natural organization of bone is still distinguishable, are capable of undergoing a slight reduction, after the removal of their cause by nature or art. Boyer states, that this sometimes happens in a few scrofulous exostoses, and particularly in such as are venereal, and not of large size.

The *cellular* exostosis of Boyer, the *fungous* exostosis of Sir A. Cooper, and the cases which are named *osteosarcomata*, are the most serious of all, especially when the texture of the bone is considerably altered, and the disease is in a state of ulceration. The rapid formation of the disease, the violent shock which it imparts to the constitution, and the hectical disturbance which it excites, generally bring the patient into imminent danger, and commonly leave no other resource but that of amputating the limb.

The treatment of exostoses is to be considered in a medical and surgical point of view. When any general cause of the disease is known, or suspected, such cause is to be removed by those means, which experience has proved to be most efficacious. Thus Boyer recommends mercurial and antiscrofulous remedies, &c. according to the nature of the case. At the present day, iodine, and the hydriodate of potash are frequently prescribed.

Whatever may be the species of exostosis, or the nature of its cause, relief, says Boyer, may be derived from the outward use of opium, whenever the disease is attended with severe pain. He speaks favourably of the application of a linseed-meal poultice, mixed with a decoction of the leaves of nightshade and henbane, to which a strong solution of opium has been added. But he thinks that an antiphlogistic plan, with bleeding, is hardly ever admissible, because it weakens the patient too much in so tedious a disease, and can only be a palliative, incapable of curing, or preventing, the ravages of the disorder.

When there is no pain, or it has been appeased, during or after any general method of treatment, which may have been indicated, the surgeon may try resolvent applications, particularly soap and mercurial plasters, the tincture or ointment of iodine, the liniment of ammonia, bathing in water, containing a small quantity of soda, or potassa, hydro-sulphuretted washes, &c. It must be confessed, however, that the progress of exostoses can scarcely ever be checked by any general methodical treatment. The muriatic and acetic acids have been administered, but without effect; nor am I acquainted with any remedies which, possess efficacy, except iodine and mercury, which last we know will rarely answer, except in cases of nodes. In the commencement of any deep-seated disease in a bone, Sir A. Cooper thinks, that the best medicine, for internal exhibition, is the oxymuriate of quicksilver in small doses, together with the compound decoction of sarsaparilla. (*Surgical Essays*, part i. p. 169.) Boyer is firmly of opinion that, with the exception of recent small exostoses, the nature of which is even doubtful, the resolution of such tumours is almost impossible. A slight diminution of the swelling, and its becoming perfectly indolent, are the most favourable changes which can be hoped for, whether they occur spontaneously, or are the fruit of surgical assistance. (*Mal. Chir.* t. iii. p. 554—557.)

Blisters have often been applied to the skin over exostoses, and kept open for a long while with savine ointment; but, although they tend to diminish venereal nodes, after they have been lessened as much as they can be by mercury, and they promote the absorption of dead bone in cases of necrosis, their efficacy in the treatment of exostoses has not been considerable. However, a trial of them in some examples is rational; and Sir Astley Cooper approves both of leeches and blisters, a discharge from the latter being kept up with equal parts of the mercurial and savin ointments. (*Surgical Essays*, part i. p. 169.)

When exostoses merely occasion a deformity, and no pain, nor inconvenience, from the pressure which they produce on the neighbouring parts, it is certainly most advisable not to undertake any operation for their removal; for, as Boyer has truly observed, in by far the greater number of instances, the local affection is much less to be dreaded, than the means used for removing it.

Caustics and the cautery have occasionally been applied to exostoses; but they mostly do mischief. Boyer mentions a woman, in whom some caustic was applied to an exostoses at the inside of the tibia; but which, instead of removing the tumour, caused a necrosis, of which she was not well two years afterwards. In a few instances, however, after the removal of fungous, or cartilaginous exostoses, of the interior of a bone with cutting instruments, the application of the cautery has prevented a reproduction of the diseased mass, as we find exemplified in a case recorded by Sir Astley Cooper, where such a disease of the jaw was thus extirpated. (*Surgical Essays*, part i. p. 158.) The bold and successful manner, also, in which the hydatid exostosis of the head was attacked with the saw, caustics, and the actual cautery, by Mr. R. Keate, is particularly entitled to the attention of the surgical practitioner. (*Med. Chir. Trans.* vol. x. p. 288, &c.) I have already noticed the occasional cure of true exostoses, not malignant ones, by an accidental attack of necrosis. Mr. Travers, aware of this important fact, has suggested the practice of removing the periosteum in some cases, for the purpose of producing the death and exfoliation of the swelling, or a part of it, when circumstances render some attempt to get rid of it urgently necessary. So far as my information extends, no attempts to stop the progress, and effect the cure of a fungous exostosis, by tying the main artery of the limb, has ever yet succeeded. Two cases, proving the inefficiency of this practice, are detailed by Sir A. Cooper. (Vol. cit. p. 170.)

As the *fungous exostosis of the medullary membrane* is evidently connected with a state of the constitution analogous to what prevails in fungus hæmatodes (see *this word*), the permanent success of amputation should never be too boldly promised; but, as no medicines have any material power over the disease, and the operation is the only chance of relief, it ought to be advised.

Cartilaginous exostoses of the medullary membrane may sometimes be extirpated by removing their outer bony covering, and then cutting away the cartilaginous matter closely from the bony surface to which it is attached. Sometimes, as I have noticed, these measures are followed by the use of the actual cautery.

Periosteal exostoses are also either *cartilaginous*, or *fungous*, which latter are attended with less general swelling of the limb, and are more prominent than fungous exostoses of the medullary membrane. Ulceration, bleeding, sloughing, and great discharge ensue, and, unless some operation be performed, the patient loses his life. (*Sir A. Cooper, Surgical Essays*, part i. p. 180.)

The *cartilaginous exostosis, between the periosteum and bone*, arises from inflammation of the periosteum, and subjacent part of the bone; and a deposition of firm cartilage, adherent to both these surfaces, takes place. In this substance bony matter is secreted, which is first thrown out from the original bone. As the cartilage increases in bulk, the quantity of phosphate of lime augments, and fresh cartilage is constantly deposited upon the outer surface of the tumour. On dissection;—1st, the periosteum is found thicker than natural; 2dly, immediately below the periosteum, cartilage; and 3dly, ossific matter, deposited within the latter from the shell of the bone, nearly to the inner surface of the periostum. When the growth of such a swelling ceases, and the disease is of long standing, the exterior surface consists of a shell of osseous matter, similar to that of the original bone, and communicating with its cancelli, in consequence of the primitive shell having been absorbed. (*Sir. A. Cooper, Surgical Essays*, part i. p. 186.) The *periosteal cartilaginous* exostoses constitute the indolent, hard forms of the disease. In their early stage, they may sometimes be checked by small doses of mercury, the decoction of sarsaparilla, and the emplastrum ammoniaci cum hydrargyro. (Vol. cit. p. 196.) When large, or troublesome, they may be sawn away, as Sir A. Cooper states, without danger, if the disease be well discriminated from the fungous swelling.

When exostoses are productive of much pain, and injure the health, and their situation admits of their being safely removed, with the aid of suitable saws, or even with that of a gouge and mallet the operation may be undertaken. Many tumours of this kind, however, have bases so very extensive, and deep, that, when situated on the limbs, amputation becomes preferable to any attempt made to saw or cut away the exostoses, and preserve the members on which they are situated.

When the part, by which they are connected to the bone is slender, their removal is generally a business of facility. I have heard of cases, in which they were accidentally broken off, and lay loose, before the operation was begun.

In removing an exostosis, its base must be as freely exposed by the knife as circumstances will allow, and to this part a small fine saw may be applied. In cutting away some exostoses, the flexible saw, described by Dr. Jeffray, of Glasgow, has been occasionally employed. Mr. Hey's saws, and the semicircular trephine, are now so well known to the profession, that I scarcely need recommend them to be remembered in the present cases. Mr. Machell, a surgeon in London, invented a saw, well calculated for cutting a bone at a great depth, without injuring the muscles. It is a small, fine, perpendicular wheel-like saw, turned by means of a handle connected with machinery. It is highly commended by Sir A. Cooper, who has given a drawing of it in his *Surgical Essays*, part 1. An orbicular saw, invented and used by Professor Graefe, of Berlin, likewise merits particular notice on account of its ingenuity. (See *C. G. E. Schwalb, De Serra Orbiculari*, 4to. Berol. 1819.) I would likewise recommend to the notice of surgeons the ingenious rotation saw, contrived by Professor Thal of Copenhagen, and of which a description and engraving may be found in the *Edin. Med. and Surgical Journal*, No. 74. A strong pair of bone-nippers, and especially cutting forceps, the edges of which are in the line with the handles, will also be useful.

E. Victorin, De Ossibus tuberosis. Upsal, 1717. *Haller*, Disp. Chir. t. iv. p. 561. *P. H. Mœhring*, De Exostosi Steatomatode Claviculæ, ejusdem felici Sectione. Gedani, 1732. *J. Caspart*, De Exostosi Cranii rariore. Argent, 1730. *J. R. Fayolle*, De Exostosi, Monsp. 1774. *Abernethy*, in Trans. for the Improvement of Med. and Chir. Knowledge, vol. ii. p. 309, *Bonn*, Descriptio Thesauri Ossium Hoviani. *Dumont*, Journ. de Méd. t. xiii. Hist. de l'Acad. des Sciences, 1737. p. 28. *Houstet*, in Mém. de l'Acad. de Chir. t. iii. *Matani*, De Osseis Tumoribus, p. 20. *Petit*, Traité des Mal. des Os, t. ii. *Morgagni*, De Sedibus, &c. ep. 50. art. 56. *Kulmus*, De Exostosi Claviculæ. *Haller*, Collect. Dis. Chir. t. iv. *R. Keate*, in Med. Chir. Trans. vol. x. Sir *A. Cooper*, Surgical Essays, part i. 8vo. Lond. 1818. *J. F. Lobstein*, Compte de son Musée Anatomique, p. 24, &c. 8vo. Strasb. 1820. *B. Bell*, On Dis. of Bones, chap. iv. 12mo. Edinb. 1828. *W. J. Wickham*, On Dis. of the Joints, p. 6. 8vo. Winchester, 1833. *Herbert Mayo*, Outlines of Human Pathology, p. 11. 8vo. Lond. 1835. Catalogue of the Museum of the Royal College of Surgeons, London, 4to.

EXTRAVASATION. (from *extra*, out of, and *vas*, a vessel.) A term, applied by surgeons to the passage of fluids out of their proper vessels, or receptacles. Thus, when blood is effused on the surface, or in the ventricles of the brain, it is said, that there is an *extravasation*. When blood is poured from the vessels into the cavity of the peritoneum, in wounds of the abdomen, or when the contents of any of the intestines are effused in the same way, surgeons call this accident an *extravasation*. The urine is also said to be *extravasated*, when, in consequence of a wound, or of sloughing, or ulceration, it makes its way into the cellular substance, or among the abdominal viscera. When the bile spreads among the convolutions of the bowels, in wounds of the gall-bladder, this is a species of extravasation. In wounds of the thorax, or abdomen, an extravasation of blood also frequently happens in the cavity of the pleura or peritoneum. Large quantities of blood are often extravasated in consequence of vessels being ruptured by violent blows: in the scrotum, on the shoulder, and under the scalp, this effect is observed with particular frequency. In the articles, Head, Injuries of, and Wounds, I have treated of extravasations of blood in the cranium, chest and abdomen.

EYE, CALCULUS IN THE INTERIOR OF. Scarpa dissected an eye, which was almost entirely transformed into a stony substance. It was taken from the body of an old woman, and was not above half as large as the sound one. The cornea appeared dusky, and, behind it, the iris, of a singular shape, concave, and without any pupil in its centre. The rest of the eyeball, from the limits of the cornea backward, was unusually hard to the touch. The particulars of the dissection of this case will be read with interest, in Scarpa's Treatise on the Diseases of the Eye.

Haller met with a similar case. (See *Obs. Pathol. Oper. Min. obs.* 15.) Fabricius Hildanus, Lancisi, Morgagni, Morand, Zinn, and Pellier, make distinct mention of calculi in the interior of the eye. Ossifications of the capsule of the lens, of that of the vitreous humor, and of, what was supposed to be, the hyaloid membrane, are noticed by Mr. Wardrop. (*Morbid Anatomy of the Human Eye*, vol. ii. p. 128. 8vo. *Lond*, 1818.)

EYE, CANCER AND EXTIRPATION OF. One of the well-known characters of carcinoma in general is to attack persons advanced in age, rather than children and young subjects. Hence, an observation, made by Desault, that cancer of the eye is most frequent in childhood, could not but appear a position inconsistent with the usual nature of the disease in general. Yet, how was this statement to be contradicted, while it was confirmed by the testimony of Bichat himself, who says, that more than one-third of the patients, on whom Desault operated in the Hôtel-Dieu for cancer of the eye, were under twelve years of age? Here truth and accuracy, as in many other questions relative to disease, would never have been attained without the aid of morbid anatomy, whereby distempers, which bear a superficial resemblance to each other, while they are in reality of a totally different nature, are prevented from being confounded together. Now, when Scarpa even goes further than Bichat, and asserts, that *in twenty-four individuals, affected with what is called carcinoma of the eye, twenty of those, at least, are children under twelve years of age*, this declaration, considered with the acknowledged propensity of cancer, on all other occasions, to attack old, rather than young subjects, might have remained a mysterious anomaly in the history of disease, had not the valuable investigations of Mr. Wardrop proved beyond all doubt, that the afflicting disease, which rendered it necessary for so many young subjects to undergo a severe operation, was *not true cancer*, but what is now denominated, by modern surgeons, *fungus hæmatodes*, or *medullary cancer*. (*Obs. on Fungus Hæmatodes*, 8vo. Edin. 1809.) As Scarpa observes, this author has afforded a solution of the question, by showing, from careful observation, founded on pathological anatomy, that the morbid change of structure in the eyeball of a child, commonly called carcinoma, is not in reality produced by cancer, but by another species of malignant fungus, to which the epithet hæmatodes is applied; a disease, indeed, equally, and, with regard to the eye, more formidable and fatal, than cancer, but distinguished from it by peculiar characters, which, not being confined to age, sex, or part of the body, attack the eyeball both of the infant and adult. (*Scarpa, transl. by Briggs*, p. 502. ed. 2.)

According to Scarpa, and, indeed, the sentiments of several other surgeons of the present day, cancer is always preceded by scirrhus, or a morbid induration of the part affected. As the disorganization increases in this hard scirrhous substance, an ichorous fluid is formed in cells within it, and afterwards extends towards the external surface of the tumour, causing ulceration of the investing parts. The compact and apparently fibrous mass is then converted into a malignant fungous ulcer, of a livid, or cineritious colour, with edges everted, and irregularly excavated, and with a discharge of acrid, offensive sanies. The scirrhus, composing the base of the malignant fungus, instead of increasing in size, now rather diminishes, but retains all its original hardness, and, after arising a certain way above the ulcerated surface, is destroyed at various points by the same ulcerative process, from which it originated. And, if any part of the livid fungous sore seem disposed to heal, it is a deceitful appearance, as, in a little time, the smooth points are again attacked by ulceration. To relate in this place all the differences between cancer and fungus hæmatodes of the eye would be superfluous, as the subject is elsewhere considered (See CANCER and FUNGUS HÆMATODES); but I may briefly advert to a few remarkable points of diversity. 1st, The primary origin of fungus hæmatodes is generally in the retina, especially that point at which the optic nerve enters the cavity of the eye. 2dly, True cancer of the eyeball, when it begins on any part of the organ itself, instead of commencing as fungus hæmatodes at the deepest part of the eye, originates on its surface in the conjunctiva; and, so far as present evidence extends, if we except the lachrymal gland, this membrane is the only texture, connected with the eye, ever primarily affected with carcinoma. (*Scarpa on Diseases of the Eye*, p. 526. edit. 2; and *Travers, Synopsis of the Diseases of the Eye*, p. 99.) 3dly, Cancer of the eye appears to Scarpa, less destructive than fungus hæmatodes, because it begins on the exterior parts of the eye, so that whatever relates to the origin and formation of the disease is open to observation; and, because a cancerous fungus on its first appearance, is not according to his views, actually malignant, but becomes so in process of time, or from improper treatment, previously to which period good surgery may be employed with effect. In this light, Scarpa regards many excrescences on the conjunctiva and anterior hemisphere of the eye, which appear in consequence of a staphyloma of the cornea, long exposed to the air and ulceration; those which arise from relaxation and chronic inflammation of the conjunctiva; from ulceration of the cornea, neglected or improperly treated; from violent ophthalmy, not of a contagious nature, treated in the acute stage with astringent and irritating applications; from suppuration of the eye, rupture of the cornea, and wasting of the eyeball; or from blows, or burns on the part. Nothing, says Scarpa, is more probable, than that all these ulcerated fungi were, on their first appearance, not of malignant character, or certainly not *cancerous*, and that many of them were not actually so at the time of a successful operation being done.

Now, in the opinion of the same valuable author, there is no criterion as yet known of the precise time when a sarcoma of the eye changes from the state of a common ulcerated fungus to that of carcinoma; for, the exquisite sensibility, darting pains, rapidity of growth, colour, and ichorous discharge, are not an adequate proof of cancer. The symptom, however, on which he is inclined to place the greatest dependence, as a mark of the change in question, is the almost cartilaginous hardness of the malignant ulcerated fungus, which induration, he asserts, is not met with in the benign fungus, and never fails to precede the formation of cancer. (See *Scarpa on the Eye, transl. by Briggs*, edit. 2. p. 511—513.)

4thly. The last difference of fungus hæmatodes from cancer of the eye, here to be noticed, is the pulpy softness of the whole of the diseased mass, in the first of these diseases; a character completely opposite to the firm almost cartilaginous consistence of the carcinomatous fungus.

What is termed fungus hæmatodes may be composed of a combination of medullary, erectile and melanotic matter; but in other instances, either of the latter may exist as a separate disease, different from fungus hæmatodes. (See *Aneurism* by *Anastomosis*, *Nævi*, and *Melanosis.*)

Before describing the operation of removing an eye, affected with malignant disease, the following corollaries, drawn by Scarpa, should be recollected. 1. The complete extirpation of the eye, for the cure of fungus hæmatodes, although performed on the first appearance of the disease under the form of a yellowish spot, deeply seated in the eye, is useless, and rather accelerates the death of the patient. But, although this statement, made by Scarpa, is mostly true, modern experience justifies the hope, that exceptions to the foregoing melancholy inference are possible. Thus, Mr. Wishart removed from a boy, nine years old, an eye that had been affected with fungus hæmatodes about four months, and no relapse had taken place eighteen months after the operation. (See *Edin. Med. and Surg. Journ.* No. 74. p. 51.)

2. The exterior fungous excrescence of the eye, commonly called carcinoma, beginning on the conjunctiva and anterior hemisphere, *while it is soft, flexible, and pulpy*, although accompanied with symptoms similar to those of carcinoma, is not actually this disease, nor does it become malignant and strictly cancerous, until it is *rigid, hard, coriaceous, warty, and, in every respect, scirrhous*.

3. The inveterate fungous excrescence, hard to the touch in all its parts, covered with ulcerated warts, which has involved the whole of the eyeball, optic nerve, and surrounding parts, and rendered the bones of the orbit carious, and contaminated the lymphatic glands behind the angle of the jaw, and in the neck, is incurable.

4. On the contrary, the partial or total extirpation of the eye will succeed, when attempted before the external fungous excrescence has changed from the state of softness to that of a scirrhous, warty, and carcinomatous hardness. (Vol. cit. p. 526.)

The operation of removing the eye is commonly believed to have been first performed in the sixteenth century by Bartisch; but, as M. Velpeau observes, it had probably been executed at a much earlier period, for J. Lange, who published in 1555, states, that he succeeded in reducing into the orbit an eye, which some other surgeons wished to extirpate. (*Nouv. Elem. de Méd. Opér.* t. i. p. 781.) Bartisch employed an instrument, shaped like a spoon, with cutting edges, and by means of which the eye was separated from the surrounding parts, and taken out of the orbit. Fabricius Hildanus preferred a sort of probe-pointed bistoury. Bidloo made use of scissors, and a pointed bistoury.

Until the time of M. Louis, no precise directions had been given about the mode of performing the operation: his method consists in dividing the attachments of the eye to the eyelids; then those of the small oblique muscle; next, those of the great oblique muscle; then those of the levator palpebræ superioris, varying, according to their insertions, the manner of holding the knife. The eyeball is afterwards detached, and the four straight muscles, and optic nerve, divided with a pair of scissors.

The following is the ordinary method: —

1*st. Stage.* If the state of the disease requires the eyelids to be removed, two semilunar incisions are first to be made at the base of the orbit, and the eyelids are to be detached from it, and dissected away with the rest of the tumour. But, when the eyelids are to be preserved, the first step consists in making an incision about an inch in length, through their external commissure. The eyelids are then to be everted, and the front of the tumour is then to be taken hold of with a tenaculum, single or double, or a ligature may be passed across it.

2*d. Stage.* The point of the knife is then introduced at the inner angle, and passed close to the ethmoid bone nearly down to the foramen opticum. It is then to be conveyed across the floor of the orbit, so as to divide the attachment of the lesser oblique muscle, the connection of the conjunctiva to the eyelid, and some adipous and cellular tissue. It is next to be brought again to the inner angle, and, with the edge turned upward, the greater oblique muscle is to be cut, and the blade carried across the upper part of the orbit, in which movement some operators endeavour to cut out also the lachrymal gland, as the knife is about to unite the two incisions near the external angular process.

3*rd. Stage.* The eye is now only retained in the orbit by a kind of pedicle, composed of the four straight muscles and the optic nerve. Supposing the operator prefers dividing it with scissors, they may be introduced on the nasal side of the orbit, with their concavity towards the swelling, and while the swelling is drawn forwards and outwards, the pedicle may bé divided at one stroke. If any fibres should remain uncut, their division must now be completed. If a long, narrow knife is preferred, it may also be introduced on the nasal side of the orbit, as recommended by Velpeau. (*Nouv. Elém. &c.*, t. i. p. 787.) This gentleman, however, does not object to introducing the knife or scissors on the temporal side as preferred by Desault, Travers, Lawrence and Malgaigne. The lachrymal gland is best removed by seizing it with a hook, and then dissecting it out of its fossa. Dupuytren used to begin with detaching the eye from the upper part of the orbit; he then divided the pedicle, and drew the swelling towards the cheek. The operation was finished by detaching the tumour inferiorly, from within outwards. Thus, there were only two stages. (See *J. F. Malgaigne, Manuel de Méd. Opér.* ed. ii. p. 402. 12mo. Paris, 1837.)

Mr. Travers, with a straight double-edged knife, freely divides the conjunctiva and oblique muscles, so as to separate the eyeball and lachrymal gland from the base of the orbit. Drawing the eye then gently forwards with the ligature, he introduces a double-edged knife, "curved breadthwise," at the temporal commissure of the lids, for the purpose of dividing the muscles, vessels, and nerves, by which the globe remains attached. The hemorrhage he represses with a small bit of fine sponge put into the orbit, and a light compress, applied over the eyelids, and supported with a bandage. The sponge, he says, should not be suffered to remain longer than the following day, when a soft poultice in a muslin bag may be substituted for the compress. He approves of giving an opiate at bed-time, and joins Ware in condemning the practice of cramming the orbit with lint or charpie, and leaving it to be discharged by suppuration. (*Synopsis of the Diseases of the Eye*, p. 308.)

As soon as the eyeball has been removed, the surgeon should examine with his finger, whether any indurated or diseased parts have been left behind, and, if they have, he should next cut them away with scissors, or the knife.

The employment of sponge is objected to by Velpeau, as likely to cause some mischief by its expansion within a solid cavity. (See *Nouv. Elém.* t. i. p. 788.) If a dossil of lint be held for a little while on the bleeding vessels, the hemorrhage will generally stop, and the plan of forcibly distending the orbit with lint, or sponge, will be unnecessary. The bleeding is from the ophthalmic artery and its branches. The bleeding having been stopped, the edges of the incision at the outer commissure are to be brought together with a suture; the eyelids approximated to one another; and some soft pieces of lint, or fine linen, wetted with cold water, laid over them.

For a few days after the operation, antiphlogistic treatment is proper. The patient should be kept in bed, until all risk from inflammation is past, and suppuration has been freely established. In one case, operated upon by Mr. Guthrie, the symptoms of inflammation were so violent, that it was necessary to take away 250 ounces of blood in the course of the three first days. (*Operative Surgery of the Eye*, p. 183.) Sometimes, fungous granulations continually form in the orbit, notwithstanding they are repeatedly destroyed; and sometimes, the disease extends even to the brain, and produces fatal consequences. When malignant fungous excrescences grow from the cornea alone, it is clearly unnecessary to extirpate the whole eyeball.

For information relating to the subjects of this article, consult particularly Mémoire sur plusieurs Maladies du Globe de l'Œil; où l'on examine particulièrement les cas qui exigent l'extirpation de cet organe, et la méthodé d'y procéder; par *M. Louis*, in Mém. de l'Acad. de Chir. t. xiii. p. 262. édit. in 12mo. *C. F. Kaltschmeid*, Programma de oculo-ulcere canceroso laborante feliciter extirpato, &c. Jenæ, 1748. *J. G. G. Voit*, Oculi Humani Anatomia et Pathologia ejusdemque in statu morboso Extirpatio, 8vo. Norimb. 1810. *Bertrandi*, Traité des Opérations de Chirurgie, p. 519. éd. 1784. Paris. *Sabatier*, De la Médecine Opératoire, t. iii. p. 54. éd. 1. *Richter*, Anfangsgr. der Wundarzn. b. iii. p. 415. Gött. 1795. Mémoire sur l'Extirpation de l'Œil Carcinomateux, in Œuvrés Chir. dé Desault par Bichat, t. ii. p.102. *Richerand*, Nosographie Chir. t. ii. p. 103, &c. édit. 2. *Ware*, in Trans. of the Medical Society of London, vol. i. part. 1. p. 140, &c. *Lassus*, Pathologie Chir. t. i. p. 450. édit. 1809. *Wardrop*, On Fungus Hæmatodes, p. 93, &c. *Scarpa*, On the principal Diseases of the Eye, chap. 21. edit. 2. transl. by *Briggs*, 8vo. Lond. 1818. *B. Travers*, A Synopsis of the Diseases of the Eye, sec. iv. 8vo. Lond. 1820. *J. H. Wishart*, in Edin. Med. and Surg. Journ. No. 74. *G. J. Guthrie*, Operative Surgery of the Eye, p. 178, &c. 8vo. Lond. 1823. *Wm. Lawrence*, *R. Middlemore*, and *Wm. Mackenzie*, in their respective Treatises on Dis. of the Eye. *Alf. Velpeau*, Nouv. Elém. de Méd. Opér. t. i. 8vo. Paris, 1832. *J. F. Malgaigne*, Manuel de Méd. Opér. p. 401. éd. 2. 12mo. Paris, 1837.

EYE, DISEASES OF. See Amaurosis; Cataract; Cornea; Encanthis; Exophthalmia; Fungus Hæmatodes; Hemeralopia; Iris; Hydrophthalmia; Hypopium; Leucoma; Nyctalopia; Ophthalmy; Pterygium; Pupil, Closure of; Staphyloma, &c. &c.

EYELIDS, DISEASES OF. See Ectropium; Lagophthalmus; Hordeolum; Ptosis;

Trichiasis; and Tumours, Encysted. In the examination of the interior of the upper eyelid, the most convenient plan is that of everting the part over a probe, placed just across the upper edge of the cartilage of the tarsus, which is then to be suddenly inclined outwards and upwards, when the whole inner surface of the lid will be exposed, the part continuing in this everted state until replaced by the surgeon.

FEVERS. Two species of fever, viz. the *inflammatory*, and the *hectic*, are particularly interesting to surgeons, because frequently attendant on surgical disorders.

In treating of inflammation, I have mentioned, that a febrile disturbance of the constitution is attendant on every considerable inflammation. In the present article, some account will be offered of the particulars of this disorder.

The fever about to be described is known and distinguished by several names; some calling it *inflammatory;* some *symptomatic;* and others *sympathetic.* It is supposed by certain writers to be sometimes *idiopathic;* that is, to originate at the same time with the local inflammation, and from the same causes. (*J. Burns.*) In other instances, and, indeed, we may say, in all ordinary surgical cases, it is *symptomatic;* or, in other words, it is produced, not directly by the causes, which originally produced the inflammation, but in consequence of the sympathy of the whole constitution with the disturbed state of a part.

Mr. Travers's opinions seem partly to coincide with those of Mr. Burns, though differently expressed. He considers constitutional irritation to be of two kinds, direct and reflected; by which he implies, "that the first is wholly and immediately derived from the part, commences and is identified with the local mischief, and the constitution has no share in its production. The second, on the contrary, originates in a peculiar morbid state of the constitution, to which the injury or inflammation has given birth, or it may be previously existing. The first is truly symptomatic, never originating spontaneously, and, being immediately induced by the local irritation, is capable of being essentially mitigated, or arrested by its removal. The second is occasionally purely idiopathic, and, being oftener the cause than the effect of the local action, is seldom influenced by the local treatment. In the first, the local changes are dependent on local causes; in the second, they depend on constitutional causes." (See *Travers on Constitutional Irritation*, p. 47.) As the expression reflected irritation, if understood in its literal sense, involves the reader in an hypothesis, which is perhaps not correct, I do not see any advantage in the employment of it. Used figuratively, however, it may be as allowable as many other expressions in medical language.

Idiopathic inflammatory fever is said to be always preceded by chilliness. The symptomatic or sympathetic inflammatory fever sometimes takes place so quickly, in consequence of the violence of the exciting cause, or of the local inflammation, that no preceding coldness is observable. If, however, the local inflammation be more slowly induced, and, consequently, operate more gradually on the system, then the coldness is evidently perceived. The symptomatic fever, induced by scalding, or burning a part, is quickly produced, and we have very little time to attend to the earliest period of its formation. On the other hand, the symptomatic fever, induced by wounds, is excited more slowly, and the period of its formation is longer. This fever is not produced, when the inflammation only affects parts in a slight degree; but it makes its appearance if the local inflammation be considerable, or if it affect very sensible parts. (*Burns.*)

The degree, in which the symptomatic fever is excited, does not altogether depend upon the absolute quantity or violence of the inflammation; but, in a great measure, upon the degree of the local inflammatory action, compared with the natural power and action of the part affected. Parts, in which the action is naturally low, are extremely painful when inflamed, and the system sympathizes greatly with them. Hence, the constitution is very much affected, when tendons, bones, or ligaments, are the parts inflamed. Severe inflammation of a large joint, every one knows, is apt to excite the most alarming, and even fatal derangement of the system. When very sensible parts are inflamed, as, for instance, the eye, the symptomatic fever is generally more considerable, than it would be, were it to arise from an equal quantity and degree of inflammation in a less sensible organ.

In common parts, as muscles, cellular membrane, skin, &c. the symptoms will be acute; the pulse strong and full, and the more so, if the inflammation be near the heart; but, perhaps, not so quick, as when the part is far from it: the stomach will sympathize less, and the blood will be pushed farther into the small vessels.

If the inflammation be in tendinous, ligamentous, or bony parts, the symptoms will be less acute, the stomach will sympathize more, the pulse will not be so full, but, perhaps, quicker; there will be more irritability, and the blood, not being propelled so well into small vessels, will forsake the skin.

It seems to be a material circumstance, whether the inflammation be in the upper or lower extremity; that is, far from, or near the heart; for the symptoms are more violent, the constitution more affected, and the power of resolution less, when the part inflamed is far from the source of the circulation, than when near it, even when the parts are similar, both in texture and use.

If the heart, or lungs, are inflamed, either immediately, or secondarily by sympathy, the disease has more violent effects upon the constitution than the same quantity of inflammation would, if the part affected were not a vital one, or one with which the vital parts did not sympathize. If the part be such as the vital ones readily sympathize with, then the sympathetic action of the latter will affect the constitution, as in an inflammation of the testicle. In such cases, the pulse is much quicker and smaller, and the blood is more sizy, than if the inflammation were in a common part, such as muscle, cellular tissue, and skin.

When the stomach is inflamed, the patient feels an oppression and dejection through all the stages of the inflammation; the pulse is generally low and quick, and the pain obtuse, strong, and oppressive; such as the patient can hardly bear. If the intestines are much affected, the same symptoms take place, especially if the inflammation be in the upper part of the canal; but, if only the colon be affected, the patient is more roused, and the pulse is fuller, than when the stomach alone is inflamed. When the uterus is inflamed, the pulse is extremely quick and low. When the inflammation is either in the intestines, testicle, or uterus, the stomach generally sympathizes. In inflammation of the brain, the pulse varies more than in the same affection of any other part; and, perhaps, we must, in this instance, form a judgment of the complaint, more from other symptoms than the pulse.

When inflammation is situated in a part not very essential to life, and occasions the general affection of the system, called inflammatory fever, the pulse is fuller and stronger than common, and the blood is pushed further into the extreme arteries than when the inflammation is in a vital part. The patient, after many occasional rigors, is at first rather roused. The pulse is as above described, when the constitution is strong and not irritable; but, if this be extremely irritable and weak, as in many women, who lead sedentary lives, the pulse may be quick, hard, and small, at the commencement of the inflammation, just as if the vital parts were concerned. The blood may also be sizy; but it will be loose and flat on the surface. (*Hunter.*)

The kind of constitution makes a great difference; and, as Mr. Travers has justly observed, "it is scarcely necessary to illustrate the influence of an irritable temperament upon the consequences of casual injury or disease. Practically, we all know it well. We say, *such a person would be a bad subject for a compound fracture;* and whoever has had opportunities of watching several subjects of compound fracture under treatment at one and the same time, well knows the inport of this phrase, and that the greatest degree of mischief is often accompanied by the least constitutional disturbance, and, for this reason, is soonest and most perfectly restored. The first few hours will enable an experienced observer to determine, whether the subject of a serious injury or operation will do well or otherwise. How vastly different in different individuals is the inconvenience attending such minor derangements as a boil, an enlarged gland, a whitlow, or a simple ophthalmia. In some, the constitution seems ignorant of the affair, and the individual pursues his ordinary occupations. In others, the whole system sympathizes; the spirits are ruffled; the nights are restless; the appetite fails; the pulse acquires an undue bound; and the white tongue, the creeping chilliness, and slight erratic pains of symptomatic fever are present." (*Travers on Constitutional Irritation*, p. 15.)

We may set down the ordinary symptoms of inflammatory fever, occurring in consequence of local inflammation in common parts, and in a healthy habit, as follows:—The pulse is frequent, full, and strong; all the secretions are diminished; the patient is vigilant and restless; the perspiration is obstructed, and the skin is hot and dry; the urine is high-coloured, and in small quantity; the mouth is parched, and the tongue furred; an oppressive thirst is experienced; with disturbance of the nervous system; loss of appetite and sleep; and, in some cases, delirium.

TREATMENT OF INFLAMMATORY FEVER.

Upon this part of the subject very little is to be said; for as, in almost every instance, the febrile disturbance of the system is produced, and entirely kept up by the local inflammation, it must be evident that the means, employed for diminishing the exciting cause, are also the best for abating the constitutional effects. Hence, it very seldom happens, that any particular measures are adopted expressly for the fever itself; as this affection is sure to subside in proportion as the local inflammation is lessened, or resolved. But, when the febrile disturbance is considerable, and the inflammation itself is also considerable, the agitated state of the system may have in its turn a share in keeping up, and even increasing, the local affection, and should be quieted as much as possible. However, in these very instances, in all probability, we should be led to a more rigorous adoption of the antiphlogistic plan of treatment, by an abstract consideration of the state of the local inflammation itself, without any reference to that of the constitution. Indeed, the increased action of the heart and arteries, and the suppression of the secretions, require the employment of antiphlogistic means, and antimonials, the very same things, which are indicated for the resolution of the local inflammation itself. Bleeding, purging, cold drinks, low diet; the exhibition of the antimonium tartarizatum, or James's powder; and bathing the feet and body in warm water, are measures, which have the greatest efficacy in tranquillizing the constitutional disturbance implied by the term inflammatory fever. But, I think it right to repeat, that it is hardly ever necessary to have recourse to such an evacuation as general bleeding, merely on account of the fever; as this is only an effect, which invariably subsides in proportion as the local cause is diminished.

As Dr. Thomson has remarked, "the inflammatory fever, succeeding to external injuries, or to chirurgical operations, undergoes a kind of natural crisis, by the appearance of suppuration. In these instances, therefore, unless when the patient is strong and in full health, when the disease is seated in an organ of much importance to life, or is in danger of spreading, as is the case in all inflammations of the membranes lining the three great cavities of the body, the lancet ought to be used with caution. For we may, by too free a detraction of blood, produce a sudden sinking of the powers of life, and convert the existing constitutional symptoms into fever of a different type or character. But, in all cases of inflammation, in which any doubt arises, with regard to the farther general detraction of blood, it may, I believe, be laid down as a general rule, that it is safer to employ local, than general blood-letting." (*Lectures on Inflammation*, p. 170.)

HECTIC FEVER.

The *sympathetic* or *symptomatic* fever already described, is an *immediate* affection of the constitution, in consequence of some local disorder; hectic fever is a *remote* effect. When hectic fever is a consequence of local disease, it has commonly been preceded by inflammation and suppuration; but there is an inability to produce granulation and cicatrization; and the cure, of course, cannot be accomplished. The constitution may now be said to be oppressed with a local disease, or irritation, from which it cannot deliver itself.

A distinction should be made between hectic fever, arising entirely from a local complaint in a good constitution, which is only disturbed by too great an irritation, and hectic fever, arising principally from the badness of the constitution, which does not dispose the parts to heal. In the first species, it is only necessary to remove the part, (if removable) and then all will do well; but, in the second, nothing is gained by a removal of the part, unless the wound, made in the operation, is much less, and more easily put into a local method of cure; by reason of which, the constitution sinks less, under this state and the operation together, than under the former disease. Here the nicest discrimination is requisite. (*Hunter.*)

Owing to a variety of circumstances, hectic fever comes on at very different periods after the inflammation, and commencement of suppuration. Some constitutions, having less powers of resistance than others, must more easily fall into this state.

Hectic fever takes its rise from a variety of causes, which have been divided into two species, with regard to diseased parts; viz. parts called vital, and others not of this nature. Many of the causes of hectic fever, arising from diseases of the vital parts, would not produce this constitutional affection, if they were in any other part of the body; such, for instance, is the formation of tumours, either in, or so situated as to press upon, a vital part, or one, whose functions are immediately connected with life. Scirrhi in the stomach, and mesenteric glands; diseased lungs, liver, &c. very soon produce hectic fever.

When hectic fever arises from a disease of a part, that is not vital, it commences sooner, or later, according as it is in the power of the part to heal, or continue the disease. If the part be far from the source of the circulation, the fever will come on sooner, with the same quantity of disease. When the disease is in parts which are not vital, and excites hectic fever, it is generally in situations, where so much mischief happens as to affect the constitution, and where the powers of healing are little. This is the case with diseases of many of the joints. We must also include parts which have a tendency to such specific diseases, as are not readily cured in any situation.

Although hectic fever commonly arises from some incurable local disease of a vital part, or from an extensive disease of a common part, yet it is possible for it to be an original disease in the constitution, without any local cause whatever, that can be specified.

Hectic is a slow mode of dissolution: the general symptoms are those of a low, or slow fever, attended with weakness. But, there is rather weak action, than real weakness; for, upon the removal of the hectic cause, the action of strength is immediately produced, and every natural function is re-established, however much it may have been previously impaired.

The particular symptoms are debility; a small, quick, and sharp pulse; the blood forsakes the skin; loss of appetite; frequently a rejection of all aliment from the stomach; wasting; a great readiness to be thrown into sweats; spontaneous perspirations, when the patient is in bed; pale-coloured, and very copious urine; and often a constitutional purging.

Hectic fever has been imputed to the absorption of pus into the circulation; but, no doubt, much exaggeration has prevailed in the doctrine which ascribes to this cause many of the bad symptoms frequently attacking persons who have sores. When suppuration takes place in particular parts, especially vital ones, hectic fever almost constantly arises. It also attends many inflammations, before suppuration has actually happened, as in cases of white swelling of the large joints. The same quantity and species of inflammation and suppuration in any of the fleshy parts, especially such as are near the source of the circulation, have in general no such effect. Hence, in the first instances, the fever is only an effect on the system, produced by a local complaint, that has a peculiar property.

The constitution sympathizes more readily with diseases of vital organs, than with those of any other parts; their diseases are also in general more difficult of cure, than the same affections of parts, which are not vital. All diseases of bones, ligaments, and tendons, affect the constitution more readily, than those of muscles, skin, cellular membrane, &c.

When the disease is in vital parts, and is such as not to kill, by its first constitutional effects, the system then becomes teased with a complaint, which is disturbing the *necessary actions of health.* In the large joints, a disease continues to harass the constitution, by attacking parts which have no power, or rather no disposition, to produce salutary inflammation and suppuration. Thus, the system is also irritated by the existence of an incurable disease. Such is the theory of the cause of hectic fever.

If the absorption of matter always produced the symptoms above described, how could any patient, who has a large sore, possibly escape hectic? for, there is no reason to suppose, that one sore can absorb more readily, than another. If absorbed matter occasioned such violent effects as have been commonly ascribed to it, why does not venereal matter do the same? We often know that absorption is going on, by the progress of buboes. A large one, just on the point of bursting, has been known to be absorbed, in consequence of a few days' sea-sickness. The person continued at sea for four and twenty-days afterwards; yet, no hectic symptoms followed, but only the specific constitutional effects, which were of a very different description.

When the cavities of veins are inflamed, matter is sometimes formed within these vessels, and cannot fail to get into the circulation; yet, though violent and dangerous disturbance of the constitution follows, hectic symptoms do not arise. Also, very large collections of matter produced without visible inflammation, as many abscesses of the scrofulous kind, are wholly absorbed in a short time, but no bad symptoms are the consequence.

We may conclude, therefore, that the absorption of pus has no share in occasioning hectic fever. Many arguments might be adduced to expose the absurdity of the doctrine; but here it will be sufficient to refer the reader to what Mr. Hunter has said further on the subject, in his work on inflammation.

It is much more probable, that hectic fever arises from the effect, which the irritation of a vital organ, or other parts, such as joints, has on the constitution, when either incurable in themselves, or are so for a time to the constitution.

TREATMENT OF HECTIC FEVER.

There is no method of curing the consequences above related. All relief must depend on the cure of the cause (viz. the local complaint), or on its removal.

Tonic medicines have been recommended, on account of the evident existence of great debility. Antiseptics have also been given, in consequence of the idea that, when pus is absorbed, it makes the blood disposed to putrefy. For these reasons, bark and wine have been exhibited. In most cases, bark will only assist in supporting the constitution. Until the cause is removed, however, there seems no prospect of curing a disorder of the constitution. It is true, tonic medicines may make the system less susceptible of the disease, and also contribute to diminish the cause itself, by disposing the local complaints to heal. When, however, hectic fever arises from a specific disease, such as the venereal, though bark may enable the constitution to bear the local affection better, than it otherwise could do, yet, as Mr. Hunter remarked, it can have little effect upon the syphilitic mischief.

No medicine, not even bark itself, has any direct power of communicating strength to the human constitution. All that can be done, in the treatment of hectic fever, when it is thought inexpedient, or impracticable, to remove the morbid part, is to combat particular symptoms, and to promote digestion. It is by bringing about the latter object, that bark in these cases is useful. The infusion of cinchona, and the sulphate of quinine, being more likely to agree with the stomach, than the decoction, or powder, should generally be preferred. Nourishing food, easy of digestion, should be frequently taken, in small quantities at a time. Nothing is more prejudicial to a weak constitution, than overloading the stomach. Wine may also be given, but not too freely, and not at all, if it should create heartburn, as it sometimes does in hectic patients. Madeira, or sherry, is less apt, than port, to have this disagreeable effect. In these cases, it is likewise often found useful to administer gentle cordial aromatic draughts. But, of all medicines, opium is perhaps the most valuable to those, who are afflicted with hectic fever: it alleviates pain, procures sleep, and checks the diarrhœa, which so frequently contributes to hasten the patient's dissolution.

When the local complaint, connected with this fever, is totally incurable, it must, if possible, be removed by a manual operation. Thus, when a diseased joint keeps up hectic fever, and seems to present no hope of cure, amputation must be performed. But, when the local disease is attended with a chance of cure, provided the state of the constitution were improved, the surgeon is to endeavour to support the patient's strength. Great discretion, however, must be exercised, in deciding how long it is safe to oppose the influence of an obstinate local disease over the system, by the power of medicine; for, although some patients, in an abject state of weakness, have been restored to health by a removal of the morbid part, many have been suffered to sink so low, that no future treatment could save them from the grave. Clemency in the practice of surgery does not consist so much in delaying strong and vigorous measures, as in boldly deciding to put them in execution, as soon as they are indicated.

When hectic fever arises from local diseases in parts, which the constitution can bear the removal of, such parts should be taken away, if they cannot be cured, consistently with the advice already given. When the disease arises from some incurable disease in an extremity, and amputation is performed, all the above-mentioned symptoms generally cease, almost immediately after the removal of the limb. Thus, as Mr. Hunter has correctly observed, a hectic pulse, at one hundred and twenty, has been known to sink to ninety in a few hours after the removal of the hectic cause. Persons have been known to sleep soundly the first night afterwards, who had not slept tolerably for several preceding weeks. Cold sweats have stopped immediately, as well as those called colliquative. A purging has immediately ceased, and the urine begun to drop its sediment.

FICATIO, or FICUS. (a fig.) A tubercle about the anus, or pudenda, resembling a fig.

FINGERS, ABSCESSES OF, see Whitlow; Amputation of, see Amputation; Dislocations of, see Dislocation; Fractures of, see Fracture.

Fingers Supernumerary.

Since allowing the redundant number of fingers to remain would keep up deformity, and create future inconvenience, the surgeon is called upon to amputate them. The redundant fingers may be with, or without, a nail; seldom more numerous than one upon each hand; generally situated just on the outside of the little fingers; and, so far as my observation extends, incapable of motion in consequence of not being furnished, like the rest of the fingers, with muscles. For the most part, the phalanges are also imperfectly formed, or deficient. The best plan is to cut off supernumerary fingers with a scalpel, at the place, where they are united to the other part of the hand. The operation should be performed while the patient is an infant, that is to say, before the superfluous parts have acquired much size, and while the object can be accomplished with the least pain. The incisions ought to be made, so as to form a wound with edges, which will admit of being brought together with strips of adhesive plaster.

Fingers, Permanent Contraction of.

Baron Dupuytren has made some interesting observations on this affection, to which each of the fingers, but especially the ring-finger, is liable. Most of the individuals, who have this infirmity, have been accustomed to make efforts with the palm of the hand, and to handle bodies of great hardness. When a tendency to the complaint begins, some difficulty is experienced in extending the fingers; and the ring-one soon becomes contracted; the carpal phalanx being first implicated, and the others afterwards inclining in the same direction. In this stage, the flexion of the two adjacent fingers becomes more marked, but no knottiness is yet perceptible in front of, and around the cord on the palmar side of the ring-finger. Its second and third phalanges are straight and moveable; the first is bent more or less to a right angle, and is moveable on the metacarpal bone; but, it cannot be put into the straight position by the most violent efforts. Dupuytren refers to a case, in which a trial was made to cure the patient by means of the application of different weights, which were increased up to 150lb, without the flexion being removed.

When the ring-finger has become very much bent, the skin is thrown into folds, the concavity of which is towards the fingers, and the convexity towards the radio-carpal articulation. On first inspection, one might suppose the skin to be diseased; but this is not the case. A tense cord is felt on the palmar side of the finger; it extends towards the first phalanx, and may be traced to the upper part of the palm. When the finger is bent, it disappears almost entirely. If attempts be made to extend the fingers, the tendon of the palmaris brevis is felt to move, and the motion is propagated to the upper part of the palmar fascia. The patient is unable to grasp largish bodies; and, if he try to take hold of them more forcibly, or an endeavour is made to extend the fingers, he experiences acute pain. The causes of this disease were formerly referred either to thickening and contraction of the skin, spasm of the muscles, disease of the flexor tendons, or that of their fibrous sheaths, or some change in the articular surfaces and lateral ligaments. All was uncertainty, when Dupuytren had an opportunity of dissecting a hand in which this infirmity existed. A drawing having been first made of it, the integuments were removed from the palm and palmar aspect of the finger, after which the folds and wrinkles had entirely disappeared. From this it was clear, that the disorder did not depend upon the state of the skin. As soon as the palmar fascia had been exposed, it was found to be tense, contracted, and shortened, and that from its inferior part cords or bands proceeded to the sides of the affected finger. On attempts being made to straighten the finger, M. Dupuytren observed, that the fascia became tense. He then divided the prolongations of it extending to the sides of the finger. The contraction ceased immediately, and the fingers assumed a very slightly bent position. In fact, the disease was ascertained to be owing to the extreme tension of the palmar fascia, brought on by a contusion of the palm, or the long continued pressure of hard substances upon it. The plan of cure, adopted by M. Dupuytren, consisted in making a transverse incision, about ten lines in length, over the metacarpo-phalangian joint of the ring-finger. The skin was first divided, and then the palmar fascia. As soon as this had been done, the finger became straight, and could be extended almost as readily as in the natural state. After the operation, the hand was fixed with a bandage, upon a piece of pasteboard, for a few weeks, and the fingers kept extended. In one case, M. Dupuytren made semicircular incisions; one at the base of the ring-finger, in order to divide the two digital and lateral prolongations of the palmar fascia, sent to this finger; the other, an inch and a quarter from the first, in the palm of the hand, for the purpose of dividing the digital prolongation at its root, and thus detaching it from the palmar fascia. (See *Dupuytren Clin. Chir.* t. i. art. 1.)

In a lecture, delivered subsequently to the preceding observations, M. Dupuytren adverts to flexions of the fingers, arising from other causes; as a previous wound of the palm known by the scar; alteration in the formation of the phalanges, by disease, and unattended with the kind of cord, observed when the palmar fascia is implicated; and a division of the extensor tendons with a cutting instrument, which parts, not being united again, leave the flexors without any antagonists. A contused wound, producing sloughing of the skin of the palm, may have the same result, if its edges be suffered to be drawn together, instead of cicatrization being completed by the formation of a new cutaneous texture. (See *Clin. Chir.* t. i. p. 521.). Burns of the palm are frequently followed by this deformity, when the preceding indication is neglected. Amongst other causes of permanent flexion, M. Dupuytren notices, deformity of the articular surfaces of the phalanges, produced by the long continued position of the fingers in certain employments, as in lacemakers, tailors, &c.; by wounds of the flexor tendons, or their displacement, in consequence of having been extensively laid open for the cure of whitlow. The wound of a joint may be another cause of contraction of the finger; and a gunshot-injury of the flexor muscles may lead to the same consequence. M. Dupuytren's observations on this subject seem to me equally original and valuable. The toes are also liable to a contraction, dependent upon a state of the plantar fascia, corresponding to that of the palmar.

FISSURE. (from *findo*, to cleave asunder.) A fine crack in a bone is so called.

FISTULA, an opening, the consequence of a wound, abscess, or ulceration; it has no disposition to heal, and is connected with a channel, or canal, running more or less deeply and extensively in the soft parts. From the resemblance of this channel to the cavity of a pipe, or reed, the term is derived. A fistula commonly leads to the situation of some disease keeping up suppuration; and from which place the matter cannot readily escape. Thus, the presence of a dead piece of bone, or of a foreign body often keeps up suppuration, and the fistula continues for the discharge of the matter. When an abscess forms near the anus, the matter lodges, and the part is disturbed by the action of the sphincter, a *fistula in ano* is produced. Sometimes a fistula is produced by the continual discharge of some healthy secretion through a wound, or ulcer, as exemplified in salivary, lachrymal, and urinary fistulæ. The lining of old fistulæ may assume the appearance of certain mucous membranes, though follicles and villi, like those of the intestinal canal, have never been observed in it. As Andral remarks, when most perfectly organized, it can only be compared to the most simple mucous membranes, such as those of the ureters, or lesser branches of the hepatic ducts. The lining of fistulæ, like mucous membranes in general, when not irritated, is pale and of a grayish colour; but, if affected with acute, or chronic inflammation, it exhibits the same shades of injection and redness, seen in a mucous texture. It is also liable to certain affections, which pertain almost exclusively to mucous membranes, as fungous growths, callosities, &c. The cellular tissue, connected with the lining of fistulæ, may become thickened, indurated, and scirrhous, just like the submucous cellular tissue in general. Finally, just as adhesions never take place between the different points of a surface, lined by a mucous membrane, unless a solution of continuity has taken place in it, so the sides of a fistulæ cannot adhere together, and its cavity be obliterated, unless incisions be made to bring the textures and the membrane-like investment of it, into contact. (See *Andral, Précis d'Anat. Pathol.* t. i. p. 261.)

FISTULA IN ANO. See ANUS.

FISTULA LACHRYMALIS. In correct language, this term can be applied only to one case, viz. that in which there is an ulcerated opening in the lachrymal sac, unattended with any tendency to heal, and from which opening the tears, and a mucous, or puriform fluid, are from time to time discharged. Such has been the confusion, however, respecting the nature of the diseases of the lachrymal passages, and so great has been the force of ancient custom, that down to the present time, the generality of British, as well as foreign surgeons, imply by the expression, *fistula lachrymalis,* several forms of disease, totally different from each other, and to only one of which the name is at all applicable. In order not to assist in perpetuating this absurd and erroneous plan, from which nothing but mistakes and ignorance can result, I shall follow the example, pointed out by Beer, Schmidt, and our countryman, Dr. M'Kenzie, and consider the various forms of disease, to which the lachrymal passages are subject, not under the head of *fistula lachrymalis,* but under that of LACHRYMAL ORGANS, DISEASES OF THE.

FISTULÆ IN PERINÆO. Incisions in the urethra generally heal with great facility; a fact, amply proved by the common result of the lateral operation: but, when apertures are formed in the urethra, either from diseased states of the constitution and the part together, or of the latter alone, and when they are accompanied with any considerable destruction of the sides of the urethra, and of the corpus spongiosum, they are difficult of cure. (*Sir B. Brodie, in Med. Gaz.* Dec. 26. 1835. No. 13.)

When the methods, recommended for the removal of Strictures (See URETHRA, STRICTURES OF,) have not been attempted, or not succeeded, nature endeavours to relieve herself by making a new passage for the urine, which, although it often prevents immediate death, yet, if not remedied, is productive of much inconvenience and misery to the patient through life. The mode in which nature endeavours to procure relief, is by ulceration on the inside of that part of the urethra which is enlarged, and situated between the stricture and the bladder. Thus the urine becomes applied to a new surface; irritating the part, and occasioning the formation of an abscess, to which the urine has access; and when the matter is discharged, be it by nature or by art, the urine passes through the aperture, and generally continues to do so, whilst the stricture remains. (*Sir A. Cooper, Surgical Essays,* part ii. p. 212.)

In some cases, a fistula in perinæo occurs as a consequence of severe gonorrhea. The urine comes away in a very small stream, because the urethra is inflamed, swollen, and contracted. At last, a pain is felt in the perinæum, a tumour is felt there; and this state is frequently attended with complete retention of urine, or with great difficulty of making water. At length the tumour bursts, or is opened with a lancet; pus is discharged; then the difficulty of making water subsides, and, a day or two afterwards, the patient finds that, whenever he voids his urine, a portion of it comes through the opening in the perinæum. (*Sir B. Brodie, in London Med. Gaz.* vol. for 1835—36. p. 486.)

The ulceration, which is always on the side of the urethra next the external surface, commonly begins near, or close to the stricture, although the stricture may be at a considerable distance from the bladder. The stricture is sometimes included in the ulceration, by which means it is removed; but, unluckily, this does not constantly happen.

The urethra having ulcerated, the urine readily gets into the loose cellular texture of the scrotum and penis, and it may diffuse itself all over those parts; and as it is very irritating to them, they inflame and swell. The presence of the urine prevents the adhesive inflammation from taking place; it becomes the cause of suppuration wherever it is diffused, and the irritation is often so great, that it produces mortification, first in all the cellular tissue, and afterwards in several parts of the skin; all of which, if the patient live, slough away, making a free communication, between the urethra and external surface, and producing what are termed *fistulæ in perinæo,* though it is plain enough to every surgeon, who knows the correct meaning of the word *fistula,* that a recent opening, produced in the perinæum by ulceration or sloughing, ought not to be called a fistula, immediately it is formed, and, at least, not until it has acquired some of the characters, specified in my explanation of the term *fistula.*

A fistula in perinæo, then, is the result of an abscess in the perinæum, communicating with the urethra at one extremity, and opening externally at the other. "The whole or part of the urine flows through the fistula, whenever the patient makes water; the constant irritation of the urine causes the sides of the fistula to become hard and callous; and, at last, a sort of button-like projection, with the orifice of the fistula in the centre, is discovered in the perinæum. The fistula differs in length, and size; and the opening into the urethra differs in size also. There is sometimes a single fistula, sometimes there are several; and, accordingly as the fistula is larger, or smaller, accordingly as there are more or less sinuses, communicating with the urethra, so does a larger, or smaller quantity of urine escape through this unnatural passage, whenever the patient makes water. Sometimes the urine, thus voided amounts to only a few drops; sometimes it comes away in a small stream; and sometimes it comes away in so large a quantity, that that which is voided by the perinæum is greater than what is voided in the natural way." (*Sir B. Brodie, in Lond. Med. Gaz.* vol. for 1835—36, p. 486.) I have seen a few examples, in which all the urine was discharged through the fistula. One of those cases, was that of a medical gentleman, whom I lately attended with Sir Benjamin Brodie. In the King's Bench, there was a man about four years ago, who had been passing the whole of his urine through a fistula in the perinæum for fourteen years; and the anterior portion of the urethra seemed to be obliterated.

Although a fistula in perinæo is productive of much distress, inasmuch as the flow of urine in this direction wets the patient's dress, irritates the integuments, and sometimes the urine causes a good deal of pain, as it is running out, the fistula, as Sir Benjamin Brodie has well observed, is not an evil unmixed with good. If a man has a stricture, it saves him from the ill consequences of a retention of urine. A spasm affects the stricture, and he cannot make water through the natural passage; but the fistula being formed, the urine escapes from it, and thus the return of retention of urine, and the ill consequences of over-distention of the bladder are prevented.

When the disease is the consequence of gonorrhæa, there is generally only a single abscess; but, when it is connected with a stricture, there may be many abscesses formed in succession. Thus, a patient, with a stricture of long standing, may have fistulæ produced in various directions, and terminating in the perinæum, the middle of the scrotum, or even in the groin, the nates, or the rectum. When the matter and urine have been freely discharged through one opening, a fresh abscess is not often formed; but, in the opposite case, several abscesses are liable to follow. (*Ib.*)

In many cases, the matter is putrid and offensive, in consequence of the pernicious effects of the urine, and the admixture of it and dead cellular tissue with the pus which is produced. Sir Benjamin Brodie is of opinion that the matter may even act as a poison on the system; and, on this principle, he partly explains the repeated shiverings during the formation of the abscess; the dry brown tongue; hot skin; frequent pulse; and other typhoid symptoms.

According to Mr. Hunter, when ulceration takes place further back than the portion of the urethra between the glans penis and membranous part of the canal, the abscess is generally more circumscribed.

A fistula in perinæo, and a general effusion of urine, producing gangrene, are both connected with ulceration of the urethra; but, as Sir Benjamin Brodie remarks, the ulceration occurs under different circumstances. "If the patient be making water in a small stream, and a little ulcer forms behind the stricture, the greater part of the urine flows out by the natural passage, and it is not probable, that more than a few drops will dribble into the cellular membrane, through the ulcerated orifice. But, if the patient has complete retention of urine; if the stricture be so contracted, that not a drop of water can pass through it; and, if then the urethra ulcerates behind the stricture; the next time the patient tries to make water, he strains with the bladder and abdominal muscles; the urine cannot pass by the natural passage, and it is driven by the muscles, as by a syringe, into the cellular membrane of the perinæum first, and into that of the scrotum, penis, and nates afterwards, and a great deal of urine is extravasated. In the one case, it *dribbles* into the cellular membrane; in the other, it is *driven* into it; and hence sloughing under certain circumstances, and an abscess under others." (*Sir B. Brodie, in London Med. Gaz.* vol. for 1835—36. p. 487.)

The urine sometimes insinuates itself into the corpus spongiosum urethræ, and is immediately diffused through the whole, even to the glans penis, so as to produce a mortification of all those parts. A fatal instance of this kind is reported by Sir C. Bell. (*Surgical Obs.* vol. i. p. 98.)

Although the ulceration of the urethra be in the perinæum, the urine generally passes easily forwards into the scrotum, which contains the loosest cellular tissue in the body; and there is always a hardness, extending along the perinæum to the swelled scrotum, in the track of the pus. (*Hunter.*)

The direction, which the extravasated urine takes, is determined by the connexion of the superficial with the deep perineal fascia below the transverse muscle. This connexion prevents the urine from extending towards the thigh, or the buttock; and, if it become very widely extravasated, it does not pass downwards, or backwards, but forwards into the scrotum and penis, and then into the groins, and cellular tissue of the parietes of the abdomen, and this nearly up to the ribs. I was lately called to a man, a patient of the Bloomsbury Dispensary, in which this course of the effused urine was exemplified.

Sir Astley Cooper is of opinion, that, as soon as the abscesses, which are the forerunners of the fistula, can be plainly felt to contain a fluid, it is best to open them. The extensive destruction of parts by ulceration will thus be prevented; the place not unfrequently then heals up expeditiously without any fistulous orifice being left, and a tendency to those dangerous extravasations of urine is also prevented, which, if the abscesses are not opened early, often prove destructive to life. (*Surgical Essays,* part ii. p. 212.)

Ulceration can only be prevented by destroying the stricture; but when the urine is diffused in the cellular tissue, the removal of the stricture will generally be too late to prevent all the mischief, although it will be necessary for the complete cure. Therefore, an attempt should be made to pass a bougie, or rather a catheter, for perhaps the stricture may have been destroyed by the ulceration, so as to allow the instrument to be introduced. When this is the case, bougies or catheters must be almost constantly used, in order to procure as free a passage as possible. In these cases Sir A. Cooper expresses a preference to metallic bougies, the size of which is to be gradually increased, until their diameter exceeds the natural diameter of the passage. In some instances, however, he considers it advisable to introduce a pewter catheter, of large size, and to allow it to remain in the bladder, so as at once to act upon the stricture, and hinder the urine from passing through the preternatural opening. In this manner, a permanent cure may often be effected. Although this experienced surgeon agrees with most surgeons of the present day, respecting the general inexpediency of employing caustic for the removal of a stricture, under the preceding circumstances, yet he admits, that instances do present themselves, in which, from long neglect the urethra, and the parts surrounding the stricture, are so altered in structure, that no instrument can be passed through the obstruction, without danger, and where the slower action of caustic is safer, than the use of a metallic bougie. (*Surgical Essays,* part ii. p. 213.) The experience of modern surgeons tends to prove, however, that particular cases form exceptions to the plan of employing bougies, or catheters, though a fistulous opening may have occurred; as when the apertures in the urethra are the consequences of ulceration and abscess, unaccompanied by stricture, and take place in a bad constitution, perhaps only preceded by a slight discharge from the urethra. Here bougies would increase the tendency to ulceration, and aggravate the local and constitutional irritation. (*Sir A. Cooper,* p. 216.) I believe, that this is the right view of the latter point, because, when an abscess and fistulous opening form from gonorrhœa, they arise not so much from diminution of the canal of the urethra, but from the tendency in certain constitutions, to have abscesses of this description produced by even slight degrees of irritation in the urethra. Hence, if a catheter be useful in such a case, it is not by dilating the urethra, but conducting the urine through it, without allowing it to enter the abscess. A bougie would serve no useful purpose.

In fistulæ in perinæo from stricture, the cure mainly depends upon the diagnosis of the primary disease,—the obstruction in the urethra. In nineteen cases out of twenty, by the time that the stricture is fully dilated, the fistula has healed. It is more easy, (as Sir Benjamin Brodie observes) for the urine to pass along the natural passage, if it be of its proper diameter, than it is for it to pass through the oblique passage of the fistula. The fistula has generally a kind of valvular opening into the urethra, which the urine does not readily enter; and when the stricture, in front of the fistula has been dilated, and the urine has a free passage in that direction, it ceases to flow in the other.

When inflammation from extravasation of urine is attended with suppuration and mortification, the parts must be freely divided, in order to discharge both the urine and pus. When there is sloughing, the incisions should be made in the mortified parts.

Frequently the new passages for the urine do not heal, on account of the stricture not being removed: and even when this has been cured, they often will not heal, but become truly fistulous, and produce fresh inflammation and suppurations, which often burst by distinct openings. Such new abscesses and openings often form, in consequence of the former ones having become too small, before the obstruction in the urethra is removed.

Such diseases sometimes bring on intermittent disorders, which do not yield to bark; but cease as soon as the fistulæ and disease of the urethra have been cured.

Cases occur where, from the communication of the fistula with the urethra being unusually large, or from there being several fistulæ, or from some other cause, the cure of the fistula, or fistulæ, does not immediately follow the removal of the stricture. Under these circumstances Sir Benjamin Brodie recommends an examination of the perinæum to be made, in order to ascertain whether there is any cavity in it, in which the urine or pus lodges. If the orifice of the fistula is such, that matter, formed at the bottom of it does not readily escape, either the orifice should be dilated, or a fresh opening made elsewhere, according to the rules commonly recognised for the treatment of abscesses in general. But, if there is no impediment of this kind to the cure, and the stricture has been duly dilated, Sir Benjamin Brodie approves of the introduction of an elastic gum catheter into the bladder, and of its being continued there for the evacuation of the urine, under which treatment a cure of the fistula will often take place.

In some instances, the latter plan should not be continued beyond a certain stage of the case: at first, the catheter kept in the urethra, frequently promotes the healing of the fistulæ; but, in the end, it may have the contrary effect, by acting at the bottom of the wound, as an extraneous body. This state of the case is particularly adverted to by Sir Benjamin Brodie:—"In many cases (says he) the permanent retention of a gum catheter in the bladder does not answer the intended purpose, with respect to the cure of the fistula. It would do so, if it altogether prevented the urine from flowing through it; but the fact is, that it does not in reality produce this effect; after three or four days, a little urine always finds its way by the side of the gum catheter, and gets into the fistula, although the greater part is drawn off through the catheter. Another circumstance also takes place. The gum catheter acts like a seton, inducing inflammation and suppuration of the mucous membrane of the bladder; and some of the pus which is secreted, passes through the fistula, and keeps it open, as much as it would be kept open by the urine itself." (*Sir B. Brodie, Op.* et vol. cit. p. 488.)

If there be reason to suspect this to be the case, the best plan is to draw off the urine three times a day, and withdraw the catheter directly after each evacuation. The aim should be to let all the urine which is secreted be thus removed by the catheter, and no opportunity afforded for it to enter the fistula. But, as Sir Benjamin Brodie has explained, and as was exemplified in the case of a gentleman, whom I lately attended, the urine sometimes cannot be comfortably retained the time required; and if the catheter be more frequently introduced it becomes a source of irritation, keeps up suppuration, and does as much harm, as if it were continually retained. In the case referred to, the permanent retention of catheters in the urethra, and the frequent introduction of them were plans both tried unsuccessfully. One or two large deep cavities, filled with matter, and communicating with the fistulæ, were laid open, and followed by considerable improvement. But the use of catheters, in any way, always led to fresh abscesses, and could never be followed up long and regularly enough, without bringing on great local and constitutional disturbance. The constitution was indeed a truly irritable one. Abscesses at length formed successively in the testes, chord, and in the cellular tissue behind Poupart's ligament. An attack of diarrhœa came on, the appetite failed, and the gentleman died.

The opening of a fistula in the perinæum may sometimes be healed by touching it with the nitrate of silver, but the deeper part of it often continues unhealed, and abscesses form again. Hence, Sir Benjamin Brodie tried the plan of stimulating the bottom of the fistula, while he took measures to prevent the orifice from healing prematurely. A small quantity of nitrate of silver was melted in a platina spoon, and the end of a probe, having been coated with it, was passed quite to the termination of the fistula, the orifice of which was then slightly touched with caustic potash. The method sometimes answered, and sometimes failed.

If all these plans prove ineffectual, Sir Benjamin Brodie is in favour of trying what the daily introduction of a good-sized metallic instrument will accomplish.

When a perinæal fistula exists, communicating with the urethra, but having no external opening, a free incision is to be made into the abscess, and the rest of the treatment conducted on the principles applicable to common fistulæ in perinæo. Sometimes a small indurated lump, not bigger than a horse bean, may be felt in the perinæum. It may keep up for a long period a kind of gleet, in consequence of urine entering its cavity, and the matter oozing into the urethra. The cure consists in puncturing it, dilating the urethra with catheters, and, if necessary, touching the deeper part of the wound with caustic potash. (*Sir B. Brodie, Op.* cit.)

Some practitioners occasionally resort to the actual cautery for healing fistulæ in perinæo, which resist milder plans.

The following method of laying open such fistulæ was more commonly followed a few years ago, than at the present day.

As little as possible of the sound part of the urethra must be opened. Hence, the surgeon is guided to the inner orifice of the fistulæ by means of a staff, introduced (if possible) into the bladder, and a probe passed into one of the fistulous passages. The probe should be first bent, that it may more readily follow the turns of the fistula. When it can be made to meet the staff, so much the better; for then the operator can just cut only what is necessary. When the fistula is so straight, as to admit of a director being introduced, this instrument is the best. When neither the probe, nor the director, can be made to pass into the staff, the sinuses are to be opened as far as the first instrument goes, and then the continuation of the passage sought and laid open. The difficulties of this dissection, however, in the thickened, diseased state of the parts in the scrotum and perinæum, are such as can only be duly appreciated by a man who has either made the attempt himself, or seen it made by others. I have seen one of the first anatomists in London fail in two instances to trace the continuation of the urethra, and baffled in the endeavour to pass an instrument. The difficulty and confusion, arising from the hardened, enlarged state of the parts, which are cut, have been well depicted by Sir C. Bell. (*Surgical Obs.* vol. i. p. 129.)

When fistulæ in perinæo have been laid open, the wounds are to be at first dressed down to the bottom, which will prevent a premature reunion of the parts near the surface, and make the granulations shoot from the bottom, so as to consolidate the whole by one bond of union. (*Hunter on the Venereal Disease*, ed. 2.; See also *Urinary Abscesses and Fistulæ.*) Sir A. Cooper's practice, in cases where a considerable portion of the urethra has been destroyed, will be hereafter noticed. (See Urethra.)

FISTULA, SALIVARY. See Parotid Duct.

FLUCTUATION. The perceptible motion communicated to any collection of purulent matter, or other kind of fluid, by applying the fingers to the surface of the tumour, and pressing with them alternately, in such a manner, that the fingers of one hand are to be employed in pressing, or rather in briskly tapping upon the part, while those of the other hand remain lightly placed on another side of the swelling. When the ends of one set of fingers are thus delicately applied, and the surgeon taps, or makes repeated pressure with the fingers of the other hand, the impulse given to the fluid is immediately perceptible to him, and the sensation, thus received, is one of the principal symptoms, by which practitioners are enabled to discover the presence of fluid in a great variety of cases. Great skill in ascertaining by the touch the presence of fluid in parts, or being endued with the *tactus eruditus*, as it is termed, distinguishes the man of experience as remarkably, perhaps, as any quality that can be specified.

When the collection of fluid is very deeply situated, the fluctuation is frequently obscure, and sometimes not at all distinguishable. In this circumstance, the presence of the fluid is to be ascertained by the consideration of other symptoms. For example, in cases of hydrops pectoris and empyema, surgeons do not expect to feel the undulation of the fluid in the thorax with their fingers; they consider the patient's difficulty of breathing, the uneasiness attending his lying upon one particular side, the œdema of the parietes of the chest, the dropsical affection of other parts, the more raised and arched position of the ribs on the affected side, the preceding rigors, fever, and several other circumstances, capable of being learned with the aid of the stethoscope, from which a judgment is formed, both with regard to the presence and the peculiar nature of the fluid.

FOMENTATION. The application of flannel or cloths wet with warm water, or some medicinal decoction. Fomentations are chiefly of use in relieving pain and inflammation, and in promoting suppuration, when this is desirable. Some particular decoctions, however, are used for fomentations, with the view of affecting, by means of their medicinal qualities, scrofulous and other sores of a specific nature. I shall merely subjoin a few of the most useful fomentations in common use.

FOMENTUM AMMONIÆ MURIATIS. ℞. Fomenti communis ℔ij. Ammon. Mur. ℥j. Spirit. camph. ℥ij. Just before using the hot decoction, add to it the ammonia muriata, and spirit.

FOMENTUM CHAMÆMELI. ℞. Lini contusi ℥j. Chamæmeli ℥ij. Aq. distillat. ℔vj. Paulisper coque, et cola. A fomentation in very common use.

FOMENTUM CONII. ℞. Fol. conii recent. ℔j. vel. fol. Conii exsiccat. ℥iij. Aq. comm. ℔iij. Coque usque reman. ℔j. et cola. Sometimes applied to scrofulous, cancerous, and phagedenic ulcers.

FOMENTUM GALLÆ. ℞. Gallæ contusæ, ℥ss. Aq. ferventis ℔ij. Macera per horam et cola. Used in prolapsus ani, and sometimes employed, as a cold application, in hemorrhoids.

FOMENTUM PAPAVERIS ALBI. ℞. Papav. Alb. exsiccati, ℥iv. Aq. pur. ℔vj. Bruise the poppies, put them in the water, and boil the liquor, till only two quarts remain, which are to be strained. Employed for the relief of pain, whether from inflammation, neuralgic affections, ulcers, &c.

FORCEPS, an instrument much employed in surgery for a variety of purposes, and having accordingly various constructions. The general design, however, of surgical forceps is to take hold of substances which cannot be conveniently grasped with the fingers; and, of course, the instrument is always formed on the principle of a pair of pincers, having two blades, either with, or without handles, according to circumstances. The smallest forceps is that which is employed in the operation of extracting the cataract, and which is useful for removing any particles of opaque matter from the pupil, after the chief part of the crystalline lens has been taken away.

Another forceps, of larger size, is that used for taking up the mouths of the arteries, when these vessels require a ligature, in cases of hemorrhage. This instrument is also frequently employed for taking dressings off sores, removing pieces of dead bone, foreign bodies from wounds, and particularly, for raising the fibres, which are about to be cut, in all operations, where careful dissection is required. This forceps resembles that which is contained in every case of dissecting instruments, and is often called the *artery* or *dissecting* forceps, from its more important uses.

Neither of the foregoing forceps is made with handles; each opens by its own elasticity; and the ends of the blades only come into contact when pressed together by the surgeon.

The following kinds of forceps are constructed with handles, by means of which they are both opened and shut: —

1. The common forceps, contained in every pocket-case of surgical instruments, and used for removing dressings from sores, extracting dead pieces of bone, foreign bodies, &c.
2. Larger forceps, employed for extracting polypi.
3. Forceps of different sizes and constructions, used in the operation of lithotomy, for taking the stone out of the bladder, or for breaking the calculus, when it is too large to be extracted in an entire state.
4. Cutting forceps, as the common bone-nippers, with transverse edges, and the sharp forceps, made with the edges in the same line with the handles, used by Mr. Liston, and others, for the division of bones.

FRACTURE. A solution of continuity of one or more bones, produced in general by external force; but occasionally, by the powerful action of muscles, as is often exemplified in the broken patella.

Fractures constitute so interesting a branch of surgery, and the accidents themselves are so frequent and important, that the more scientific and successful views now entertained of the whole subject, than those prevalent forty or fifty years ago, must be highly gratifying to every admirer of the incessant progress of surgery towards perfection. Nor is this branch of surgery simply mechanical, or restricted to the consideration of bandages, splints, and other apparatus; but comprises questions and investigations not surpassed, in respect to their scientific character, by any others in the whole range of surgery.

Mr. Pott, it is true, made many excellent observations on the treatment of fractures in general, and his remarks on compound fractures in particular are in some respects the best which are extant; but what surgeon will now presume to defend the weak arguments upon which he has founded the doctrine of paying unqualified attention to the relaxation of the muscles, as if this were an object which should constantly supersede every other consideration, and invariably regulate the posture of the limb? I have no hesitation in declaring my own belief, that the doctrine and practice recommended by Pott, in regard to fractured thighs, have done considerable harm, and the more so, as coming from a man, who was deservedly looked upon as one of the best and most experienced judges of surgical practice. Many a surgeon in this country implicitly believed every thing which was asserted by so able a master; and the very observations, which some years ago were here considered to be the glory of their author, and the pride of English surgery, are now exposed by the surgeons of neighbouring countries, as specimens of wrong precepts and bad practice. M. Roux, in fact, had but too much room for animadversion upon this subject. (See *Voyage fait à Londres en* 1814, *ou Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise*, p. 173, &c.) Still Pott's observations on the use of the 18-tailed bandage, the necessity of quietude, the principles on which splints ought to be constructed, and his inestimable remarks on compound fractures, are excellent, and will long survive some of his other tenets.

So long as the process, by which broken bones unite, was less correctly understood, and while the symptoms, characteristic of each particular fracture had been less minutely traced than at the present time, this department of practice must have been conducted under great disadvantages. The several complications of fracture are also now more accurately comprehended, and more judiciously considered. Bandages are applied, not for useless display, but to promote and fulfil some more desirable purpose; some indication, which the circumstances of the accident truly require to be accomplished. The same may be said of all the mechanical contrivances employed in the treatment of fractures. For such improvements, and others, which will be noticed in the course of this article, the public are indebted to numerous labourers, amongst whom I may cite as eminently distinguished, Desault, Pott, Boyer, Dupuytren, and Sir Astley Cooper. The observations of Sir Astley Cooper, on fractures of the joints, are indeed highly creditable to this part of English surgery.

To the experiments and investigations of Duhamel, Breschet, Sanson, Cruveilhier, and Dupuytren, we are principally indebted for all the most valuable information yet extant relative to the formation of callus; a subject, however, which has not been neglected by British surgeons, as will be hereafter noticed. The perfection to which the mechanical aids have been brought, is owing likewise to the ingenuity of many individuals, especially Desault, Boyer, Assellini, Sir Astley Cooper, Dupuytren, Amesbury, Earle, M'Intyre, and Greenhow. The inventions of the two latter gentlemen, with reference to the treatment of broken legs, deserve every commendation.

Let it not be any longer supposed, that the treatment of fractures is only a mechanical business. In fact, whoever pretends to be capable of conducting it efficiently, without a due acquaintance with anatomy and pathology, and the principles on which inflammation, abscesses, gangrene, wounds, ulcers, and erysipelas, hæmorrhage, and various febrile disturbances of the constitution should be treated, must absolutely be a simpleton, or an impostor; for all these complications frequently accompany or follow fractures. Under such circumstances, what man of common sense would trust his limb and life to a mere bone-setter? But, the sequel of this article will enable the reader to judge of the truth of of these observations

1. Differences of Fractures.

The differences of fractures depend upon what bone is broken; what portion of it is fractured; the direction of the fracture; the respective position of the fragments; and, lastly, upon circumstances accompanying the injury, and making it simple, compound, or variously complicated.

1. *In respect to the bone affected.* Sometimes it is one of the broad bones, as the scapula, the

sternum, or the os ilium. Sometimes it is a short bone, like the os calcis; but, far more commonly, it is one of the long bones. The situation and functions of the broad bones render their fractures unfrequent. The bones of the skull are the only exception to this remark; for, they are often broken; but, here the assistance of the surgeon is required less for the solution of continuity itself, than for the affection of the brain, and the extravasation of blood, with which the case is apt to be combined. Fractures of the short bones are still more unusual, because these bones, being nearly equal in their three dimensions, are capable of greater resistance, and are not much within the reach of external violence. Besides, most of them are but little exposed to the operation of outward force, by their situation, or functions. Hence, except when limbs are crushed, fractures of short bones are generally caused by muscular action, which frequently breaks the patella, and sometimes the olecranon, and os calcis. The long bones, which serve as pillars, or arches of support, or levers, are, from the very nature of their functions, particularly liable to fractures.

2. *In respect to the part of the bone broken.* The long bones may be fractured at different points. Very often their middle portion is broken, and, in this circumstance, they usually break like a stick, which has been bent beyond its extensibility by a force applied at each end of it. Sometimes the fracture occurs more or less near the extremities of the bone, which is always an unfavourable event. Lastly, the bone is sometimes broken in several places, and the injury may be produced by two different causes, which operate successively, or simultaneously, upon the broken parts of the bone; or it may be occasioned by one single cause, which acts at the same moment upon several points of it. These distinctions of fractures, deduced from their particular situation (says Boyer), are not mere scholastic refinements; they have a truly important influence over the prognosis and treatment.

3. *In respect to the direction in which the bone is broken.* Thus, fractures are distinguished into *transverse* and *oblique*. The obliquity renders the surface of the injury larger, and materially increases the difficulty of maintaining the ends of the bone in contact, after the fracture has been set. Oblique fractures are subject to considerable variety, which depends upon the degree of their obliquity, and whether they are partly oblique and partly transverse. When a bone is broken in different places at once, and divided into several fragments, or splinters, the fracture is termed *comminuted.*

Duverney admitted another class of fractures, viz. *longitudinal.* (See *Maladies des Os,* t. 1. p. 167.) Such cases were regarded by J. L. Petit as only imaginary, because he conceived, that any blow, capable of breaking a bone longitudinally, would more readily cause a transverse fracture. For the same reason, Louis absolutely rejected the possibility of longitudinal fractures.

The following case, however, is related by Leveillé. An Austrian soldier, who was put under his care in the year 1800, in consequence of being struck by a ball in the lower third of the leg at the battle of Marengo, and who had walked to Pavia, a distance of several miles, after receiving the injury. In the end, amputation became necessary, and Leveillé preserved the tibia, upon which the impression of the ball was distinguishable. From this point proceeded several longitudinal and oblique lines, which extended from the lower third, towards the upper head of the tibia, and passed through the whole thickness of the parietes of the medullary canal. They were acknowledged to be really longitudinal fractures, by Dubois, Chaufrier, Duméril, Deschamps, and Roux. (*Nouvelle Doctrine Chir.* t. ii. p. 158.)

In several cases of fractured thigh-bones from gunshot violence, which were under the care of Dr. Cole and myself in Holland, the bone was split longitudinally to the extent of seven or eight inches. The fact, however, that bullets and other balls do produce longitudinal fractures, is now universally admitted; and were there any doubt upon the subject, a specimen sent to England by the late Dr. Cole would soon remove it. Boyer, who formerly denied the possibility of longitudinal fractures, was latterly of a different opinion:—"*On trouve néanmoins, à la suite des plaies d'armes à feu, les os fendus suivant leur longueur, jusques dans leurs articulations,*"—but he is correct, when he adds, that such instances afford no proof of the possibility of a simple longitudinal fracture. (See *Maladies Chir.* t. iii. p. 10.) M. J. Cloquet has recorded a case, in which the fall of a building buried a man in the ruins, and occasioned several longitudinal fractures. (See *Pathol. Chir.* 4to. Paris.)

4. *In regard to the respective position of the fragments.* These differences are highly important, because the treatment essentially consists in obviating, or preventing, the displacement of the fragments. It is not to be supposed, however, that such displacement is a constant effect of all fractures, for it seldom takes place where there are two bones, and only one of them is broken. Neither does it invariably happen in every fracture of the neck of a bone, as is exemplified in certain fractures of the neck of the thigh-bone, the fragments of which sometimes change their relative situation only when the limb is too freely moved about. Fractures of the leg are also observed, in which there is neither a displacement of the fragments, nor an alteration in the shape of the limb, especially when the tibia alone is fractured near its upper part, where it is very thick. When the ulna alone is broken at its upper part, there is hardly ever any displacement. The corresponding surfaces of the fragments having a large extent cannot be separated, or can only be so with difficulty. Fractures of the fibula are also frequently unattended with displacement. But, when both bones of the leg or fore-arm are fractured together, there is generally more or less displacement; and such is also the case when a fracture occurs in the thigh, or upper arm, where there is only one bone. Here, the little extent of the surfaces of the fracture, and the great number of muscles, facilitate displacement.

The displacement may happen in respect to the diameter, length, direction, or circumference, of the bone.

In respect to the diameter. In transverse fractures, this kind of displacement is frequently exemplified. The two fragments may either be in contact at a part of their surfaces, or they may not be in contact at all. In the latter circumstance, the limb is shortened by the ends of the fracture slipping over each other.

In respect to length. The mode of displacement, in which the ends of the broken bone pass more or less over each other, is chiefly noticed in oblique fractures, but sometimes in transverse ones, when the displacement, in the direction of the diameter of the bone, has been such that the surfaces of the fracture are no longer in contact. Whenever the limb is shortened, it is by displacement of the lower fragment.

To the species of displacement here spoken of, may be referred that which takes place in fractures of the patella, olecranon, and os calcis; but with this difference, that the fragments, instead of passing over each other, recede from each other in the direction of the length of the bone, and continue separated by a more or less considerable interspace.

In respect to the axis of the bone. In this kind of displacement, the two fragments where they meet, form an angle, and the bone appears bent. This displacement is often termed the *angular deformity.* It may occur in the leg, when the limb does not lie upon a surface exactly horizontal, and the heel is lower than the rest of the limb. The angular projection is then anterior. On the contrary, it would be posterior, if the heel were too much raised. In fracture of the shaft of the thigh, it will happen if the lower part of the limb be too much depressed, or elevated, or placed too much outwards or inwards.

In respect to the circumference of the bone. This displacement occurs when the lower fragment performs a rotatory movement, while the upper one continues motionless. Thus, in fractures of the neck of the femur, if the foot is badly supported by the apparatus, its weight, together with that of the limb, and the action of the muscles, inclines it outward, and turns the lower fragment in the same direction. This is called the rotatory displacement.

Besides these displacements, there are others of a more complicated nature, which happen in several directions at once. For example, such is the displacement, observed in a fracture of the thigh-bone, when the lower fragment is drawn upward and inward, while the foot is turned outward.

With respect to the causes of displacement, I may remark, that as the bones are only passive instruments of locomotion, they possess not, in their own organisation, any power capable of causing the change of situation which takes place; but yield to the impulse of external bodies, the weight of the limb or part, and the action of muscles.

The displacement may be produced by an external force, either at the moment when the fracture happens, and by the very action of the same cause, as breaks the bone: or it may be caused by the weight of the body when the fracture precedes the fall; or, lastly, it may be brought on by some other external force, acting on the fragments, sooner, or later, after the occurrence of the injury.

The outward violence operates sometimes directly on the situation of the fracture; sometimes on parts more or less distant from it. In both cases, the action of the force is not confined to the production of the fracture, but is partly spent in causing a displacement of the fragments.

Fractures are generally occasioned by falls. Sometimes, however, the fall does not happen till after the leg, or thigh, is actually broken. The weight of the body then produces the displacement, by pushing the upper fragment against the soft parts, which are more or less lacerated. This is what happened to Ambrose Paré who, being kicked by a horse, endeavoured to get out of the way, but instantly fell down, and the two bones of his left leg, which had been fractured, being impelled by the weight of the body, not only passed through the skin, but even through his stocking and boot. Boyer saw a nearly similar case, in a young man, who was struck on the middle of the thigh by the pole of a carriage, which fractured the femur. The patient fell down, and in the fall the upper fragment was not only driven through the muscles and integuments, but also through his breeches.

The weight of the limb itself may produce displacement according to the direction, or circumference of the bone, as already detailed. The disturbance of the limb, also, in lifting the patient, and carrying him to his bed, may sometimes alter the relative situation of the fragments, and cause displacement.

But of all the causes of the displacement of fractures, the action of the muscles is the common and most powerful. Amongst the muscles, surrounding a fractured bone, some are attached to it throughout its whole length, and are equally connected with both the fragments. Some arise from the bone above, and are inserted either into that, which is articulated with the lower fragment, or into the lower fragment itself. Lastly, others come from a point more or less distant, and terminate in the upper fragment. The muscles around the thigh-bone furnish examples of these three arrangements. The adductor is attached to the bone through the greater part of its length. The long portion of the biceps, the semi-membranosus, and semi-tendinosus, come from the pelvis, and are inserted into the leg, a part, with which the lower fragment is articulated, and all the motions of which it follows. The tendon of the adductor magnus is inserted into this fragment itself. Lastly, the iliacus, psoas, pectineus, &c. come from the loins and pelvis, and are attached to the femur, not far from its upper end.

The muscles attached to both fragments, perhaps contribute but little to the displacement. They may, however, draw them to the side on which they are situated, and thus change the direction of the limb.

The displacement is principally owing to such muscles as are affixed to the lower fragment, or part with which this fragment is articulated. Suppose the humerus to be broken between its upper end and the insertion of the great pectoral. This muscle, aided by the latissimus dorsi and teres major, will draw the lower fragment inward, and displace it by drawing it to the inner side of the upper fragment, which remains motionless. In fractures of the neck of the thigh-bone, the upper fragment, included within the capsular ligament, affords attachment to no muscle; but all those which are affixed to the lower fragment tend to draw it upward and backward. In all cases, the lower fragment follows every movement made by the part of the limb with which it is articulated, and, consequently, the muscles, attached to the bones of this last part of the limb, become a powerful cause of displacement. Thus, in a fracture of the thigh-bone, the biceps, semi-tendinosus, and semi-membranosus, draw the leg, and with it the lower fragment, upward, inward, and backward, so as to make the lower end of the fracture ascend at the inside of, and rather behind, the upper one, the extremity of which then projects forward and outward. In a fracture of the leg, the gastrocnemius, soleus, and peronei muscles, acting upon the foot, draw the lower fragments of the tibia and fibula to the outer and posterior side of the upper fragments. For here, as well as every where else, the strongest muscles, in producing the displacement, draw towards their own side the end of the fracture, on which they operate. And as the posterior muscles of the leg are far more numerous and powerful than the anterior, while those on its outside are not antagonised by any others, the displacement must happen in the direction backward and outward. Whenever, therefore, a bone is fractured at a given point, the knowledge of the muscles will enable a surgeon to determine *à priori* in what direction the displacement is disposed to happen.

Lastly, the muscles, attached only to the upper fragment, may contribute to the displacement. In a fracture of the thigh, situated immediately below the little trochanter, the psoas and iliac muscles carry forward the extremity of the upper fragment, which elevates the integuments, and forms a more or less considerable projection near the fold of the groin. But the displacement of the upper fragment is generally less considerable and important than that of the lower.

The manner in which the displacement of fractures is effected by the action of muscles explains one circumstance which frequently attends these cases, especially fractures of the thigh, clavicle, and leg. This is a rising, a projection, of the upper fragment, or that which is nearest the trunk. One might believe, at first sight, that such projection is formed by the upper fragment quitting its natural situation, and rising over the lower one. But, on the least reflection, it becomes manifest, that the upper end of the fracture projects only because the lower one is displaced, and drawn towards that side on which the strongest muscles are situated. Thus, in practice, in order to make the *rising end of the bone* (as it was termed) disappear, it is only necessary to reduce the lower fragment. If, instead of doing this, pressure be made on the projecting part, the design fails; and if the plan be still more forcibly pursued and continued, inflammation, ulceration, and sloughing, and the conversion of the case into a compound fracture, are likely to be the consequences.

5. *In respect to circumstances, with which fractures are accompanied.* The most important division of fractures is into *simple* and *compound*. By *simple fracture*, surgeons mean a suddenly formed breach in the continuity of one, or more bones, without any external wound, communicating internally with the fracture. By a *compound fracture*, they signify the same sort of injury of a bone, or bones, attended with a laceration of the integuments, which laceration may be produced by the protrusion of one, or both ends of the fracture, through the skin, or by a ball, or other body, which enters, or otherwise wounds, the soft parts, at the same moment that it breaks the bone.

Fractures are said to be *complicated* when attended with diseases, or accidents, which render the indications in the treatment more numerous, and require the employment of different remedies, or the practice of sundry operations, for the accomplishment of the cure.

Thus, fractures may be *complicated* with severe degrees of contusion, wounds of the soft parts, injury of blood-vessels, a dislocation, or diseases, and particular states of the constitution, as the scurvy, rickets, syphilis, cancer, pregnancy, &c.

The complication of fracture with dislocation is frequent in the ancle and vertebral column. In the first case, the dislocation usually precedes the fracture; but, in the second, the fracture of the body or bodies of the vertebræ, precedes the dislocation, which otherwise is exceedingly rare.

Under the head of differences in fractures may be fitly introduced that injury to the bones of children, which is denominated a *bending* of them from falls, blows, and external violence, since this injury requires the same treatment as fractures, although crepitus and displacement of the fragments do not attend it. In 1821, Dr. J. R. Barton, of Philadelphia, published a valuable paper on the subject, including also remarks on another injury to the bones of children, which he calls a *partial* or *incomplete fracture* of a single bone, or both bones. These cases had been previously noticed by Underwood and Boyer, and perhaps by them alone. Dr. Barton has illustrated his paper by very accurate drawings of the deformity, resulting from both of these accidents. (See *Amer. Med. Recorder for* 1821 and *Reese's Amer. ed. of this Dictionary.*) In the course of three years, Mr. Hart, of Dublin met with five cases of partial fracture of long bones: one of the humerus; two of the radius; and two of the femur. "The diagnostic symptoms of this affection (he observes) are pain and a bent state of the bone injured, without absolute shortening of the limb. On the contrary, it is lengthened on the side, to which the ends of the fractured part project." (See *Dublin Journ. of Med. Science*, vol. i. art. i. 8vo. 1832.)

2. The Causes of Fractures.

Are divided into *predisposing* and *remote*.

In the first class are comprehended the situations and functions of the bones, the age of the patients, and their diseases. Superficial bones are more easily fractured, than those which are covered by a considerable quantity of soft parts. The functions of some bones render them more liable to be fractured than others; thus the radius, which supports the hand, is more liable to be fractured than the ulna. The clavicle, which serves to keep the shoulder in its proper position, and support on its arched extremity all the motions of the upper limb, is particularly subject to be broken. The gradual increase of the quantity of the phosphate of lime, in the structure of the bones, makes them brittle, in proportion as we advance in years; and, in old age, the proportion of the inorganised to the organised part is so great, that the bones are fractured by the slightest causes. In childhood, the animal and organised part bears a greater proportion to the earth, and the bones being, consequently, more elastic and flexible, are not so easily broken as in old age.

Lues venerea, cancer, rickets, scurvy, and scrofula, predispose to fractures. B. Bell mentions two venereal patients, of whom the hardest and largest bones were completely broken by the ordinary action of the muscles of the limb. Sir Benjamin Brodie had a patient, whose clavicle broke exactly in the situation of a venereal node. (See *Med. Gaz.*) In the museum of University College, London, are two thigh-bones, taken from a patient, who was using mercury for the cure of syphilis: one has several nodes upon it; the other broke as he was turning himself in bed. Fabricius Hildanus quotes from Sarazin, a physician of Lyons, the case of a gouty patient, sixty years of age, who, in putting on his glove, broke his arm above the elbow. Desault used often to speak of a nun of Salpetrière, whose arm was broken, as a person was handing her out of a carriage. Louis, who was vexed that no union took place, was not a little surprised to find her thigh-bone experience the same fate one day as she was changing her posture in bed. It was then learned, that she had a cancer in her right breast. Leveillé observed similar cases in the Hôtel-Dieu; Sir Astley Cooper has met with others; and at this present time (March 1837), there is in the North London Hospital a woman with cancer of the breast, whose humerus was broken about a fortnight ago by the ordinary action of the muscles. A few months ago she was in the same institution for a similar occurrence; and she had previously sustained the same kind of injury of other bones. A few years ago, I attended a gentleman's coachman, who had a cancerous disease of the bladders and whose thigh-bone broke at its upper third, as he was turning himself in bed. Around the fractured part a scirrhous mass had been deposited between the periosteum and the bone; and one of the ribs was found in a similar condition, and also broken. The preparations are placed in the museum of University College. (See *Med. Chir. Trans.* vol. xvii.)

According to Leveillé, the history of two girls is related by Buchner, one of whom died rickety at the age of sixteen, having broken the femur a short time before her death; and the other, after taking the breast very well for two years, and thriving for a time, became affected with rachitis, and met with the same accident as she was merely running along the street. (*Nouvelle Doctrine Chir.* t. ii. p. 163.)

Many extraordinary instances of fractures from the morbid softness and fragility of the bones are upon record. Suffice it here to refer to the Philosophical Transactions; Mém. de l'Acad. Royale des Sciences; Act. Hafniens.; Ephem. Nat. Cur. dec. 1. ann. 3. obs. 112; Gooch's Chirurgical Works, vol. ii; Saviard, Obs. Chir. p. 274; Gibson's Institutes of Surgery, vol. i. p. 370, &c. (See *Fragilitas* and *Mollities Ossium.*)

On the subject of fractures, produced by the scurvy, Marcellus Donatus; Saviard; Heyne de Morbis Ossium; Poupart's Works inserted in the Mém. de l'Acad. des Sciences, 1699; and the Treatise published at Verona, in 1761, by Jean de Bona, may be consulted. To these works I would add Lord Anson's Voyage, in which the effect of the scurvy in producing the absorption of the callus of old fractures, a disjunction of the fragments, and a renewal of ulcers which had been many years healed, is curiously exemplified.

Paré, Platner, Callisen, and several other writers, set down cold as a predisposing cause of fractures. This doctrine has originated from these injuries being more frequent in the winter time, but is erroneous, since, in cold countries, the greater number of falls which happen in winter from the slippery and very hard state of the roads, is a circumstance that fully explains why fractures are then more common than in summer.

The remote cause of fractures is external force variously applied, in falls, blows, &c. In particular instances, the bones are broken by the violent action of the muscles attached to them; this is almost always the case with the fractured patella. Occasionally the olecranon and os calcis have likewise been broken by the violent contraction of the muscles inserted into them. With respect to the heel, Petit records two instances, one of which was communicated to him by Poncelet, and the other seen by himself in Madame La Présidente de Boissire, who met with the accident in walking a gentle pace in the court of the Hôtel de Soubise. When the injury happens in leaping, or falls from a high situation, Leveillé thinks it more probable, that a portion of the os calcis is torn off by the powerful action of the muscles of the calf, than that it is broken by any blow immediately on the part. He states, that Desault used frequently to cite two examples of this kind, one of which is recorded in his Œuvres Chirurgicales.

Whether the long bones can be fractured by the mere action of the muscles, has been a disputed point. In the Philosophical Transactions, a fracture of the humerus is ascribed to this cause; and Botentuit knew of the same accident being produced as a person was striking a shuttlecock with a battledore. According to Debeaumarchef, as a man was descending a ladder at a quick rate, his heel got entangled in an opening, and he made a violent exertion to avoid falling. The consequence was a fracture of the lower third of the leg. Curet informs us, that a cabin-boy, aged seventeen, made a considerable effort to keep himself from being thrown down by the rolling of the ship. The femur was fractured by the powerful action of the muscles of the thigh. The lad had no fall, and, with some difficulty, supported himself on the other limb, till he received assistance.

We are told, says Leveillé, by Poupée Desportes, that a negro, about twelve or thirteen years old, was seized with such violent spasmodic contractions of the muscles of the lower extremities, that the feet were turned backward, and the neck of each thigh-bone was fractured, the ends of the broken bones also protruding through the skin upon the outside of the thigh. A cure was effected after an exfoliation. We read also, in the Miscellanea Curiosa Acad. Naturæ Curiosorum, that during a fit of epilepsy, a child, ten years old, had its left humerus and tibia broken, and that, upon opening the body, other solutions of continuity were observed. Chamseru assisted in dressing a child, eleven or twelve years old, that had broken the humerus in throwing a stone a considerable distance. (*Nouvelle Doctrine Chir.* t. ii. p. 164. 166.)

It is the belief of Richerand, however, that a long bone, when healthy, can never be broken by the mere contraction of the muscles. (*Nosogr. Chir.* t. iii. p. 12. édit. 4.)

For my own part, making all due allowance for the inaccuracy of some of the reports, I think the possibility of the long bones being broken by the violent action of the muscles is sufficiently proved. I have never seen but one example; but it was an unequivocal one; I attended, for the late Mr. Ramsden, an exceedingly strong man, at Pentonville, who broke his os brachii in making a powerful blow, although he missed his aim, and struck nothing at all. The whole limb was afterwards affected with vast swelling and inflammation. This man, I remember, was also visited by Mr. Welbank senior. According to Nicod, the greater number of fractures of long bones, by mere muscular action, are preceded by pains in the broken limbs; and, in one of the cases, published by this author, not only was this circumstance remarked, but an abscess and exfoliation of a portion of the fractured humerus ensued. In another instance, reported by this gentleman, the clavicle, in a state of preternatural fragility from disease, was fractured in an effort to carry the arm far behind the back. After the reunion of the fracture, an abscess took place, and a piece of the bone exfoliated. (*Annuaire Méd. Chir. des Hôpitaux de Paris*, p. 494—498, &c. 4to. Paris, 1819.)

3. Symptoms of Fractures.

Some of the symptoms of fractures are equivocal: the pain, and inability to move the limb, commonly enumerated, may arise from a mere bruise, a dislocation, or other cause. The crepitus; the separation and inequalities of the ends of the fracture, when the bone is superficial; the change in the form of the limb; and the shortening of it; are circumstances, communicating the most certain information: and the crepitus, in particular, is the principal symptom to be depended upon, though occasionally attendant on dislocations, and arising, as Sir Astley Cooper has explained, from a change in the quality of the synovia. (*On Dislocations, &c.* p. 6.) The signs of fractures, however, are so exceedingly various, according to the bones, which are the subject of injury, that it cannot be said, that there is any one, which is invariably present and characteristically confined to them. The writers of systems of surgery usually notice loss of motion in the injured limb, deformity, swelling, tension, pain, &c. as forming the general diagnosis of fractures. However, it is easily comprehensible by any one, acquainted with anatomy, that numerous fractures cannot prevent the motion of the part, nor occasion outward deformity; and every surgeon must know, that though, at first, there may be pain in the situation of a fracture, no inflammation, swelling, and tension can take place till after a certain period. There may be, however, a swelling produced in the first instance by extravasation of blood, or by displacement of the ends of the bone.

When, therefore, a limb is broken, and the event is not manifest from the distortion of the part, it is proper to trace, with the fingers, the outlines of the suspected bone: if it be the tibia, let the surgeon examine with his fingers, whether any inequality can be discovered along the anterior surface, and along the sharp front edge of that bone. If it be the clavicle, let him trace the superficial course of the bone, in the same attentive manner. Wherever any unusual pain occurs, or any unnatural irregularity appears, let him try if a grating or crepitus cannot be felt, on endeavouring to make one end of the suspected fracture rub against the other. When the humerus, or the os femoris, is the subject of inquiry, a crepitus is felt almost as soon as the limb is touched; and, in the case of the broken thigh, there is a considerable shortening of the extremity, except in a few cases of fractures, completely transverse. But when there are two bones as in the leg and the fore-arm; and only one is broken, the other continues to prevent the limb from being shortened, and thrown out of its natural shade, so that a crepitus can only be felt by a very careful examination with the fingers. The difficulty of the diagnosis is increased, when the surgeon is consulted late, and great swelling has come on. "Where is the surgeon," says Boyer, "that has not sometimes hesitated to deliver an opinion in certain cases of this description?" (*Malad. Chir.* t. iii. p. 27.)

When the injured limb is shortened, the surgeon, before pronouncing that such change proceeds from the passage of the fragments over each other, must be sure, that the bones are not dislocated, and that the limb is not naturally shorter, than the other, or in consequence of a previous fracture, that has been badly set.

In comparing the length of the lower extremities, one should place the pelvis in a horizontal position, and put the two anterior superior spines of the ossa ilium in the same line: for, if these processes are not on a level, the limb, towards which the pelvis inclines, will seem longer than the opposite member.

The practitioner who is well acquainted with the anatomy of the limbs, and particularly with the mutual relations of the eminences of the bones to each other, will readily perceive the alterations produced by a fracture. Whenever, in consequence of a fall, or blow, a limb becomes concave at a part where it ought to be convex, or straight, *et vice versâ*, the change of shape and direction must proceed from a fracture with displacement. The inner edge of the great toe, when the leg rests on a horizontal surface, should correspond with the inner edge of the knee-pan. If this natural relation be altered; if the inner edge of the great toe correspond with the outer edge of the knee-pan, there can be no doubt of the existence of a fracture of both bones of the leg. (*Boyer*, vol. cit. t. iii. p. 25.)

I am aware that considerable harm, and great unnecessary pain, have been occasioned by too much solicitude to feel the grating of fractured bones, and, whenever the case is sufficiently evident to the eyes, the practitioner who gives way to this habit, at the expense of torture to the unfortunate patient, ought in my opinion to be severely censured. A fracture is an injury necessarily attended with a great deal of pain, and followed by more or less swelling and inflammation; and to increase these evils, by roughly or unnecessarily handling the part, is ignorant and cruel, and (if I may use the expression) unsurgical.

In some kinds of fractures, the broken bone is so surrounded with thick fleshy parts, that it is difficult to feel a crepitus, or ascertain the existence of the injury. Some fractures of the neck of the thigh-bone are cases illustrative of this observation. In very doubtful cases, the stethoscope has been proposed as a means of elucidating the diagnosis, and Lisfranc is said to have used it with success. (See *Edinb. Med. and Surg. Journ.* No. 78. p. 237.)

4. Prognosis of Fractures.

The prognosis of fractures varies, according to the kind of bone injured, what part of it is broken, the direction of the breach of continuity, and what other mischief complicates the case. Fractures of bones, which have many strong muscles inserted into them, are more difficult of cure than those of other bones, which have not so many powers attached to them capable of displacing the fragments.

A fracture of the middle part of a long bone is less dangerous than a similar injury near one of its joints, which may be followed by synovial inflammation and anchylosis. Thus, in a fracture of the thigh-bone, near the condyles, the inflammation and swelling extend to the knee-joint, which is affected with a degree of stiffness that continues for a long while, and sometimes cannot be entirely cured during life. The experiments of M. Cruveilhier prove, that various forms of irritation will make the periosteum ligaments and cartilages ossify; and it has been ascertained, that in some cases of fracture near the joints, the ligaments have sometimes been converted into bone. (See *Andral. Anat. Pathol.* t. i. p. 300.)

Inflammation of a joint, brought on by fracture, is attended with more severe symptoms, in proportion as the contusion has been more violent. In a fracture near an articulation, it is to be observed, also, that common splints have little command over the short fragment, so that it is often difficult with them to prevent displacement; and, with respect to transverse fractures of the neck of the thigh-bone *within the capsular ligament*, although the possibility of the reunion of such cases *by means of bony matter*, is no longer a disputed point; the cure is more commonly effected only by means of a fibrous ligamentous substance.

When a bone is fractured in several places, the case is more serious, and the difficulty of cure greater. But, the accident is still worse, when a limb is fractured in two different places at once; as, for instance, in the thigh and leg. Here, without the assistance of a double oblique plane, or M'Intyre's excellent apparatus, it would be almost impossible to reduce the fracture of the thigh and maintain the reduction well, so as to preserve the natural length of the limb.

Oblique fractures are more troublesome, and difficult of cure than transverse ones, because an oblique surface does not resist the retraction of the lower portion of the broken bone, and consequently the ends of the fracture are kept duly applied to each other with difficulty.

Fractures, complicated with violent contusion of the soft parts, or with a wound, rendering them *compound*, are much more dangerous than others free from such accidents. The bad symptoms, which render compound fractures so dangerous, are of many kinds: hemorrhage; violent and extensive inflammation of the limb, either phlegmonous or erysipelatous; delirium and fever; large abscesses; gangrene; &c. Fractures of the leg are generally more serious than similar injuries of the upper extremity. The wound of a large artery may add considerably to the danger of a fracture.

In a debilitated old man, or an unhealthy subject, or a constitution predisposed to inflammation, particularly erysipelas, or to violent derangement of the nervous system, a fracture is less likely to end well than in a healthy child, or a strong young person, or one of good constitution. In extreme old age, the cure of a fracture is always more difficult, and sometimes impossible. (*Boyer*, t. iii. p. 32.) The scurvy certainly retards the formation of callus, and, as I have already noticed, even produces its absorption again; but it is not true that pregnancy always prevents the union of fractures. Some years ago, I attended, for Mr. Ramsden, a woman in a court leading out of St. Paul's Churchyard, who broke both bones of her leg when she was several months gone with child. Her pregnancy, however, did not appear to be at all unfavourable to the cure, as it followed in the usual time. "It is not generally settled," says a modern writer, "whether pregnancy should be accounted a complication. I, as well as some other practitioners, have seen a pregnant woman get well of a simple fracture in the ordinary time." (*Leveillé, Nouvelle Doctrine Chir.* t. ii. p. 159.) And in another place he says, "*Contre l'opinion de Fabrice Hildan, l'expérience m'a prouvé que, chez les femmes grosses, le cal était aussi prompt à se former, que chez toute autre personne.*" (*Op.* cit. t. ii. p. 172.) The experience of Boyer also tends to prove, that pregnancy does not generally prevent the union of fractures. (See *Mal. Chir.* t. iii. p. 32.)

The cases, in which fractures remain disunited, will be considered in a future section.

5. Treatment of Fractures in general.

The treatment embraces three principal indications. The first is to reduce the pieces of bone into their natural situation. The second is to secure and keep them in this state. And the third is to prevent any unpleasant symptoms likely to arise, and relieve them if they come on.

The first indication is only applicable to cases attended with displacement; for, when the fragments are not out of their relative position, the surgeon must strictly refrain from all avoidable disturbance of the limb. His interference should then be limited to putting up the fracture, resisting the accession of unfavourable symptoms, and removing them, if possible, after they have taken place.

6. Of the Reduction of Fractures.

The means employed for the reduction of fractures in general are chiefly three, viz. *extension*, *counter-extension*, and *coaptation*, or *setting*. But, as Boyer remarks, these means should vary according to the species of displacement; and surgical writers have generalised too much in representing them all three as necessary for the reduction of every kind of fracture. In fact, there are several cases, in which extension and counter-extension are positively useless: of this nature are fractures of the patella and olecranon, where the displacement consists of a separation of the fragments. Here the reduction may be accomplished, by putting the limb in a position in which the muscles attached to the upper part of the bone are relaxed, and then pushing the upper fragment into contact with the lower.

Extension signifies the act of pulling the broken part in a direction from the trunk, with the view of bringing the ends of the fracture into their natural situation. By counter-extension, surgeons imply the act of making extension in the opposite direction, in order to hinder the limb, or even the whole body, from being drawn along by the extending power, which would then be unavailing.

It was formerly recommended to apply the extending force to the lower fragment, and the counter-extension to the upper one. Such practice, indeed, was advised by Mr. Pott, and is still generally preferred in this country; but upon the Continent it has been abandoned. The objections made to it by Boyer are: first, that it is frequently difficult, and sometimes impossible, to take hold of the two fragments; as, for example, when the neck of the thigh-bone is broken. Secondly, that by applying the extension and counter-extension to the broken bone itself, most of the muscles which surround it are compressed, and such compression produces in these organs a spasmodic contraction, which often renders the extension and counter-extension useless, and sometimes even hurtful. (*Mal. Chir.* t. iii. p. 34.) The French surgeons, therefore, apply the extending force to that part of the limb which is articulated with the lower fragment, and the counter-extension to that which is articulated with the upper. For instance, in a fracture of the leg, the extending means act upon the foot, and the counter-extending upon the thigh; and in a fracture of the thigh, the extension is applied to the leg, while the counter-extending power fixes the pelvis.

One circumstance must here occur to the mind of the surgical reader. In this country, it is properly inculcated, that one of the first principles to be attended to in the reduction of fractures, is to put the limb in such a position as will relax the most powerful muscles connected with the broken bone; because these muscles principally impede the reduction, and disturb the ends of the fracture. But, in the French mode of making the extension and counter-extension, how can this grand principle be conveniently fulfilled? If the extending and counter-extending means are not to be applied to the broken bone itself, but to others which are articulated with it, the limb must of necessity be kept in a straight posture at the time of reducing the fracture; for were the limb placed in a half-bent state, the extension and counter-extension, as practised by the continental surgeons, would not be in the same line, and therefore less efficiently and readily accomplished. If it be advantageous to bend the limb at the time of reducing a fracture, the French mode of practising extension and counter-extension may not be the best. I am not, however, one of those surgeons, who are entirely blinded with the idea of the possibility of relaxing the whole of the muscles connected with the broken bone, by merely bending the limb. On the contrary, I am convinced with Desault, that, in general, what is gained by the relaxation of some muscles, is lost by the tension of others. But where it is possible to relax, by a certain posture, the set of muscles most capable of preventing the reduction and disturbing the coaptation of a fracture, that posture I would select. Thus, in a fracture of the leg, the strong muscles of the calf undeniably possess this power, and the bent position which relaxes them, appears to me, therefore, generally the most judicious and advantageous, not only during the reduction, but during the whole treatment of the case. Many years ago, I had under my care, in the military hospital at Cambray, a fracture of the tibia and fibula, which was at first treated in the straight posture. The gentlemen who assisted me reduced the fragments, and made them lie tolerably well. But every time the bandage was opened, the bones were always found displaced again. Finding that this inconvenience went on for two or three weeks, we resolved to lay the limb on its outside, in the bent position. Not the least trouble was afterwards experienced in keeping the fragments reduced. In the North London Hospital, I had a strong athletic bricklayer with an exceedingly oblique, almost a longitudinal, fracture of the leg, and, notwithstanding the aid of M'Intyre's apparatus, and the trial of the bent position, the projection of the upper fragment could not be prevented. The straight posture was then resorted to; but this caused the displacement to be still greater. The bent posture as advised by Pott, with the limb laid on its outside, was then tried, but in vain; and we were obliged ultimately to return to the bent position on M'Intyre's apparatus, as the most effective. The case terminated without deformity. Unless, therefore, the situation of the fracture very high up the leg, or of a wound, abscess, or some other particular reason, indicate an advantage or convenience from the straight posture, I always reduce a fractured leg in the bent position.

I was also formerly of opinion, that the bent position of the limb on its side, as advised by Pott, was the best for fractured thighs; but this sentiment has subsequently appeared to me erroneous, and it gives me pleasure to have this opportunity of declaring my entire conversion to the principles and practice adopted in these cases by Desault and others, who urge the necessity of endeavouring to render the apparatus more efficient. The considerations which led me to this change will be related in speaking of fractured thighs. If, then, the straight posture be advantageous for broken thighs, I think it will be universally allowed, that the parts of the limb recommended by the French surgeons for the application of the extension and counter-extension, are the most proper.

The evils and difficulties formerly encountered in setting fractured limbs undoubtedly proceeded in a great measure from the violent extension and counter-extension practised by our ancestors. As they were ignorant of the utility of relaxing the muscles, which displaced the ends of the broken bone, they had no means, but the employment of actual force, to effect the reduction. Since, however, the excellent instructions delivered by Pott have received due attention, practitioners have generally been careful, in the reduction of fractures, to incapacitate the muscles as much as possible by relaxing them, and thus all necessity for violent extension and counter-extension has been removed.

It is difficult to lay down rules respecting the precise degree of force which should be used in making extension; for it must vary in different cases, according to the species of displacement, and the number and power of the muscles concerned in producing it. In transverse fractures, displaced only according to the diameter of the bone, a very moderate extension suffices, as it is merely practised with a view of lessening the friction and pressure of the surfaces of the fracture against one another. But whatever be the direction of the fracture, when the fragments pass over each other, the extension and counter-extension should be such as to remove the shortening of the limb, and overcome the force of those muscles, which, after all attention has been paid to their relaxation, still oppose the reduction.

Extension, however, ought never to be practised in a violent and sudden way; but, in as gradual a manner as possible, the utmost care being taken not to shake, nor even move, the limb any more than can be avoided. When the practitioner extends a broken member all at once violently, he excites the muscles to strong spasmodic action, and there is some danger of lacerating them, because their fibres are not allowed the requisite time to yield to the force which elongates them. The extension is to begin in the direction of the lower fragment, and be continued in that which is natural to the body of the bone.

In every case of fracture with displacement, as soon as the necessary extension has been made, the surgeon is to endeavour to place the ends of the broken bone in their natural situation: this is termed *coaptation*, or *setting*. This operation is to be undertaken in different ways, according to the species of displacement, and the practitioner can almost always execute it by acting upon the lower fragment, without applying his fingers directly to the fracture itself, in order to regulate the contact of the extremities of the bone. When, however, it is judged necessary for this purpose to touch the broken part itself, it should be done with the utmost gentleness, so as to avoid pressing the soft parts against the points and splinters of bone.

Although the reduction of fractures may in general be accomplished with tolerable facility, it sometimes happens that the first attempts fail. This is occasionally ascribable to the employment of too much force, and too little management, in making the extension; whereby the muscles are irritated, and act so powerfully, that the design of the surgeon is completely frustrated. Here, the grand means of success is putting the limb into such a position as will relax the most powerful muscles which oppose the reduction. Sometimes, however, the irritable and convulsive state of the muscles is not the effect of any wrong mode of proceeding on the part of the surgeon; but arises from the alarm, pain, and injury caused by the accident itself, the comminuted state of the bone, the irritation of spiculæ, or the very oblique direction of the fissure. Here relaxing the muscles is also the most likely method of removing the difficulty. In short, now that the utility of paying attention to this principle is universally known in the profession, a fracture is rarely met with which cannot be immediately reduced; particularly if opium be given, and a copious bleeding be premised when the patient is a strong muscular subject. This evacuation, indeed, will also prove for other reasons highly beneficial, where the limb is much contused and swollen, and the tendency to inflammation is great. But supposing the bone can not be made to lie well at first, it will easily be made to do so in the course of a few days, when the tendency to spasm has diminished, and the pain and first irritation have subsided. Only let the surgeon watch and regulate the position of the limb about this period, and the cure will be completed without any deformity.

7. Of the Means for keeping Fractures reduced.

After the bones have been put into their natural situation, time alone would complete their cure, were there not in the muscles a continual propensity to displace the ends of the fracture again. In cases of fracture, the muscles are often affected with involuntary spasmodic action, by which the broken part would certainly be displaced, were no measures taken to maintain the extremities of the broken bone in contact. Besides, the patient, in easing himself, coughing, sneezing, &c. must unavoidably subject the limb to a degree of motion, by which the coaptation would be altogether destroyed. Hence, the necessity of employing means for fixing the broken limb so effectually, that it may continue perfectly motionless during the whole time requisite for the union of the fracture. The means, employed for the fulfilment of this indication, are: an advantageous position; quietude; bandages; splints; and various kinds of apparatus.

In the treatment of all fractures, the position of the part, and indeed of the whole body, is a thing of material importance. Whenever the case is a fracture of the lower extremities, the patient should lie strictly in bed, until the callus is completely formed and strong. It is likewise an advantage not to have the bed too wide, because the surgeon and assistants can then more conveniently get at any part of the limb. As featherbeds are too yielding, a horse-hair mattress is preferable. Boyer, indeed, is so impressed with the utility of letting the patient lie upon a surface, which will not sink, that he recommends two mattresses to be used, and a board to be laid under the upper one, from the hip to beyond the patient's foot. (*Mal. Chir.* p. 39. vol. iii.)

Generally the most favourable position for a fractured limb is that, in which all the muscles, passing over the fracture, and extending either to the lower fragment, or to that part of the limb, which is articulated with it, are equally relaxed. The injured limb should also have firm support at every point, and its position ought to be regulated, so that not only this object be carefully fulfilled, but at the same time the chance of displacement from the action of the muscles, or the weight of the body, or part itself, may be diminished as much as possible.

The natural, or rather the most easy, position of the limb, is that which is usually chosen by a person who reposes himself, or who is sleeping; for then all motion is suspended, and every part assumes that posture which is most congenial to it. In this condition, the limbs are not extended, nor yet entirely bent; but only in a moderate state of flexion. Hence, Boyer remarks, that a half-bent position of the limbs is that which is most natural, and that in which all the muscles enjoy an equal degree of relaxation, and, consequently, that it is, generally speaking, the best for fractures. This posture, which was recommended by Hippocrates and Galen, has been highly extolled by Pott, who appears to have exaggerated its advantages. Considered in a general way, it is without contradiction preferable to every other position of the limb; but its employment should be liable to exceptions, as will be noticed in treating of particular fractures. (See *Traité des Mal. Chir.* t. viii. p. 40.)

In whatever position a broken limb is placed, it should bear, throughout its whole length, equally and perpendicularly upon the surface on which it lies, and not be only partially supported. When, for example, only the extremities of a fractured limb rest upon the bed, the weight of the limb itself will make it bend in the situation of the fracture. The limb will also be rendered crooked, if the broken part be supported, while the extremities of the limb (especially the inferior), sink lower by their own weight. The displacement of the fracture is not the only inconvenience arising from the limb being laid upon a surface, where it is not every where equally well supported The parts which bear on this surface, experience a painful degree of pressure, which, if long continued, may produce inflammation, and even sloughing of the integuments. Thus, in fractures of the leg, gangrene of the heel has sometimes arisen entirely from this cause. Such inconveniences may often be prevented by laying a fractured limb on a surface of corresponding form; that is to say, on a surface, which is depressed where the limb has projections, and rises where it presents depressions. The surface should not be so hard as to annoy the patient; yet it ought to be sufficiently firm not to yield to the weight of the limb and apparatus. The best pillows and pads for the support of broken limbs are stuffed with chaff of oats, a substance which is preferable to feathers, tow, or wool, because it more readily admits of being pushed from the place where the limb is prominent to another situation where the member presents a depression or hollow.

In whatever position fractured limbs are placed, they ought to be kept perfectly quiet during the whole time requisite for the union. If the broken bone be moved while the callus is forming, the surfaces of the fracture rub against each other, and the process is disturbed and retarded; and, indeed, sometimes by repeatedly moving the limb, the consolidation of fractures is entirely prevented.

In order to maintain the limb in the right position, and in a state of quietude, and to preserve the fragments in proper contact with respect to each other, the surgeon is to caution the patient to avoid moving more than can be helped, and every cause likely to subject the limb to any kind of shock or concussion is to be removed. But, in particular, it will be necessary to apply a retentive apparatus, usually consisting of bandages, splints, tapes, straps and buckles, soft pads, &c.

At St. Bartholemew's Hospital, it has been customary ever since the time of Pott, to apply to the integuments over a simple fracture a plaster of brown soap cerate; and many surgeons still follow the same plan. "If this plaster be employed, it should be put on in such manner as that it may be renewed and shifted as often as may be necessary without moving the limb in any manner: it being certain, that when once a broken thigh or leg has been properly put to rights, and has been deposited properly on the pillow, it ought not ever to be lifted up, or moved from it again without necessity, until the fracture is perfectly united." (*Pott.*) In the North London Hospital, neither the soap nor any other plaster is commonly used for simple fractures. I know, however, of no objection to it, and often employ it in private practice, on the principle that it affords some trivial support and protection to the injured part, and is mostly agreeable to the patient.

With respect to bandages, the common roller answers for fractures of the humerus, radius, ulna, and fibula. Indeed, when M'Intyre's apparatus is made use of, or Desault's method of treating a broken thigh is followed, it is the most eligible bandage for all simple fractures of the lower extremity, and even for some compound ones. But if a broken thigh or leg is to be treated according to Pott's directions, then the eighteen, or many tailed bandage is necessary. The advantages of it are that, by means of it, all necessity is avoided of lifting up, and disturbing the limb, every time it is dressed, or every time the bandage loosens. Indeed, with it the leg or thigh need never once be removed during the cure, from the pillow or splint, on which it has been deposited.

The same advantage, however, is obtained with common rollers, when M'Intyre's apparatus is used, which, as well as the limb itself, is to be encircled by them. (See *Description of a Splint invented for the Treatment of Fractured Limbs by James M'Intyre*, 8vo. Newcastle, 1825.) In the North London Hospital we dispense with the sock, and fix the limb with three rollers: one surrounds the upper part of the leg and the knee; another binds the foot to the foot-piece and encircles the ankle; and the third is applied to the central part of the leg, including the situation of the fracture. This last roller admits of being taken off, and the fracture, simple or compound, examined, without meddling with the other rollers, which steady the upper and lower parts of the leg, and therefore it does not undergo the slightest disturbance. On the whole, I cannot fancy that any apparatus for broken legs, will ever fulfil its purposes better than that of Mr. M'Intyre, which has also the recommendation of great simplicity. A very cheap form of this apparatus has lately been contrived by Mr. Liston, the peculiarities of which are the omission of most of the thigh part, and the placing of an aperture at the point where the heel lies, so that the painful pressure on this part is considerably lessened. However, those surgeons who prefer to treat fractured thighs in the flexed position, with the patient on his back, will find M'Intyre's apparatus, as arranged by himself, exceedingly convenient.

Another surgeon of Newcastle, Mr. T. M. Greenhow, is also the inventor of an exceedingly ingenious apparatus for fractures of the lower extremity. It enables the surgeon to bring the whole circumference of a broken leg into view, after the fracture has been set, without the least movement or disturbance of any part of the limb. This, as every man of experience knows, is a great advantage in the treatment of compound fractures, where the application of dressings to the wound sufficiently often, the prompt discharge of abscesses, the preservation of the parts in a cleanly state, and the opportunity of inspecting the position of the ends of the fracture in the early stages of the formation of the callus, are objects contributing very essentially to the favourable progress and termination of these accidents. With this apparatus permanent extension either of the leg or thigh, if judged advisable, may be adopted, there being a contrivance for this object. One chief principle of Mr. Greenhow's apparatus is, that the limb remains supported in an iron framework, after every thing else has been removed. (See *T. M. Greenhow's Description of an Apparatus intended to facilitate the Treatment of Fractures, &c.* 8vo. Lond. 1833.)

In France, the preference is given to Scultetus's bandage in almost every instance, where we employ the eighteen-tailed one, from which it principally differs in being composed of separate transverse pieces admitting of removal, so that when a part of the bandage is soiled, it can be taken away, and a clean piece, (first stitched to that which is about to be removed,) drawn under the limb, without disturbing the whole of the dressings. Dupuytren was partial to this bandage, not only in cases of compound fracture, but others where a frequent change of parts of the bandage was rendered necessary by the discharge.

As a general remark, we may say, that some apparatus of the foregoing kinds, a double oblique plane, or else splints, are unquestionably the most efficient of all the applications made to a broken limb, with the view of keeping the ends of the fracture steady, and in a proper state of contact.

"Splints," says, Pott, "are generally made of pasteboard, wood, or some resisting kind of stuff, and are ordered to be applied lengthways on the broken limb; in some cases three, in others four; for the more steady and quiet detention of the fracture.

"That splints, properly made and judiciously applied, are very serviceable, is beyond all doubt; but their utility depends much on their size, and the manner in which they are applied.

"The true and proper use of splints is to preserve steadiness in the whole limb, without compressing the fracture at all. By the former they become very assistant to the curative intention; by the latter they are very capable of causing pain and other inconveniences; at the same time that they cannot, in the nature of things, contribute to the steadiness of the limb.

"In order to be of any real use at all, splints should, in the case of a broken leg, reach above the knee, and below the ankle; should be only two in number, and should be so guarded with tow, rag, or cotton, that they should press only on the joints, and not at all on the fracture.

"By this they become really serviceable; but a short splint, which extends only a little above and a little below the fracture, and does not take in the two joints, is an absurdity, and what is worse, it is a mischievous absurdity.

"By pressing on both joints, they keep not only them, but the foot steady; by pressing on the fracture only, they cannot retain it in its place, if the foot be in the smallest degree displaced; but they may, and frequently do, occasion mischief, by rudely pressing the parts covering the fracture against the edges and inequalities of it.

"In the case of a fractured os femoris, if the limb be laid in an extended posture, one splint should certainly reach from the hip to the outer ankle, and another (somewhat shorter) should extend from the groin to the inner ankle. In the case of a broken tibia and fibula, there never can be occasion for more than two splints, one of which should extend from above the knee to below the ankle on one side, and the other splint should do the same on the other side." (See *Pott's Chir. Works*, vol. i. p. 298, &c. edit. 1808.)

Splints, double oblique planes, and other kinds of support for broken limbs, must always be lined with pads of tow, oat-chaff, or other soft materials, for otherwise their pressure would cause severe pain, inflammation, ulceration, and even sloughing.

Assalini strongly disapproves of the employment of all tight bandages, and of covering the whole of a broken limb with splints. He was called to a gentleman of rank at Paris, who had broken the knee-pan transversely. He laid the limb upon a concave splint, the shape of which was adapted to the under surface of a part of the leg and thigh. No bandage was used, merely two leather straps, which crossed upon the knee, and included the fractured bone. A perfect bony union was thus easily effected. Assalini afterwards extended the use of a concave splint, applied under the limb, to fractures of the leg and thigh. In the first of these cases, however, only the thigh is received in the hollow splint, and from this two lateral splints go along the leg. The apparatus has also a kind of sole for the support of the foot. As this simple contrivance is fastened with a very few straps, and no plasters, or bandages are used, the surgeon has constantly a view of the whole front of the limb, and of the fractured part of it. In compound fractures, he covers the wound with linen compresses, wet with cold water. (*Manuale di Chirurgia, Parte prime*, 1812.) See SPLINT.

So convinced is Baron Larrey of the advantage of keeping broken limbs perfectly motionless, after they have been properly set, that he sometimes employs an apparatus which moulds itself to the shape of the limb, then hardens, and remains applied during the whole of the treatment, unless circumstances call for its earlier removal. The apparatus is made by wetting the pads, compresses, and bandages in a lotion, containing the acetate of lead and white of egg, which, when it has dried, leaves the apparatus sufficiently hard and stiff to afford full support and steadiness to the limb, with the advantage of being most perfectly accommodated to the exterior of it. This plan is followed, not merely in simple, but compound fractures, and when there is a necessity for removing the patient any distance, is found by Larrey highly expedient.

In oblique fractures of the the thigh, and sometimes even in those of the leg, the difficulty of accomplishing by the ordinary means a cure free from deformity, and especially without a shortening of the limb, led to the idea of employing permanent extension. This expression implies the operation of a bandage, or machine, which continually draws the fragments of the broken bone in contrary directions, at the same time that it restrains them from gliding over each other, and maintains them in contact during the whole time necessary for their union. In England, this practice has long been relinquished. It appears to have been chased away by the dazzling theory of relaxing every muscle in such manner as to render it incapable of displacing an oblique fracture. Desault saw, however, great inconsistency in the doctrine of the possibility of relaxing the muscles, so as to incapacitate the whole set of them connected with a broken thigh; and he never ceased to inculcate that a mechanical apparatus was the main thing by which the shortening of the limb was to be prevented. When we consider the treatment of fractured thighs, we shall find that the principle of permanent but moderate extension has had in France advocates of great talent and eminence, though it is a method to which many surgeons in this country entertain strong objections.

By means of permanent extension (observes Boyer), we not only succeed in uniting the fracture, while the limb preserves its natural length; but, we afford the part a steadiness which is singularly favourable to the formation of the callus. In order to derive from permanent extension the utmost benefit, and render the method as little painful as possible, and supportable during the whole time of treatment, he recommended the machines and bandages to be constructed and applied conformably to the following rules.

We should avoid compressing the muscles which pass over the situation of the fracture, and the elongation of which organs is necessary to restore to the limb the length which it has lost by the gliding of the fragments over each other.

The extending and counter-extending force ought to be divided upon as large surfaces as possible.

The powers, making permanent extension, should act according to the direction of the axis of the broken bone.

The extension should be practised in as slow, gradual, and insensible a manner as possible.

Lastly; the parts, upon which the extending and counter-extending force acts, should be defended; and the compression, made by the tapes, or other pieces of the bandage and apparatus, ought to be equalised. (*Mal. Chir.* t. iii. p. 56. 59.)

If we consider the principles on which the mechanical means operate usefully in the treatment of different fractures, we shall find that they are various. For the most part, they have this effect by holding the ends of the fracture steadily in contact, maintaining the proper length of the limb, and hindering motion not only of the broken bone itself but of the joints connected with it, without which object being fulfilled, the fracture must always be liable to hurtful disturbance. In fractures of the shafts of the femur and humerus, and of the tibia, fibula and bones of the fore-arm, the apparatus acts beneficially in all or some of these ways; but, on certain occasions, it accomplishes its purpose, not by any direct action on the broken part of the limb itself, but by holding the limb in a particular position, and maintaining its due length. Thus, when the neck, or upper part of the thigh-bone is broken, the apparatus can have but an imperfect effect, by its direct operation on the fracture, this portion of the bone being, as it were, not within its immediate grasp. But, by holding the limb in the right position, keeping it steady, and preventing its retraction, and the eversion or inversion of the foot, it accomplishes all which it is in the power of surgeons to do, especially if care be taken to let the pelvis and broken portion of the bone be so connected together by the apparatus, as to render them, as it were, one piece, only moveable together, in every movement of the patient, or change in the surface on which he is lying.

Frequently position does every thing, without the slightest attempt to make any direct pressure on the fracture, or to act upon it immediately by any other means. This is exemplified in fractures of the clavicle, cases, in which, as well as several others, we see no splints at all employed, the requisite position of the arm and shoulder being maintained with a sling roller and pad in the axilla. Even in some cases where a splint is employed, it only operates by fixing the limb in the desirable position, as illustrated in fractures of the olecranon. In these last cases we do also use mechanical means to keep the upper fragment from ascending too far; but, in other instances, position and quietude are the only principles in operation, as in the treatment of fractures of the coracoid and acromion processes of the scapula. Here the relaxation of the muscles by position, and quietude of the shoulder, are the only essential things to be attended to, and, whatever mechanical means are employed, are not designed to act directly on the broken parts of the bone.

Occasionally, the application of splints, bandages, and other mechanical means should be deferred. This is proper in fractures near joints, as of the olecranon, patella, &c. where the inflammation and swelling prohibit any compression of the part. Under such circumstances, the first indication is to subdue the inflammation by means of cold applications, bleeding, &c., care being taken, however, to lay the limb in a judicious position.

8. Means for preventing and removing the unfavourable Symptoms liable to arise from Fractures.

After having reduced the fracture, applied the apparatus for maintaining the reduction, and put the part in an advantageous position, the practitioner is to attend to another indication, viz. the prevention and removal of any unfavourable symptoms.

With the exception of a few simple fractures of the upper extremity, it is proper to allow for the first few days only very low diet. When the patient is young, and strong, and the swelling and inflammation considerable, venesection should be practised. In other circumstances, it may be dispensed with, because it is well known, that for the quick formation of callus, by which the fracture is to be united, strength and a vigorous circulation are highly favourable. The patient may be permitted to drink as often, and as much as he likes, of any cooling acid beverage. A very low diet is only to be continued the first few days, unless great inflammation arise; for experience proves, that the method, when too much prolonged, has bad effects, and tends, on the same principle as bleeding, to retard the union of the fracture.

Costiveness is to be obviated by the use of mild aperient medicines. It must be confessed, however, that in fractures of the lower extremity, the disturbance of the limb caused by the patient's being obliged to move himself, after taking a purgative, is seriously objectionable; but, perhaps, in all, and certainly in some, habits, the neglect to open the bowels soon after the accident, would have still more pernicious consequences. In order to lessen the disturbance, a bed-pan should be introduced under the patient. Here, also, I feel it my duty to recommend to the notice of the profession a very complete fracture-bed invented by my friend, Mr. Earle. One great convenience of this bed, the cost of which is moderate, is to enable the patient to void his feces, without the slightest change of position, or disturbance; an object effected by the simple contrivance of a little kind of trap, opening under the bed, out of which a small portion of the mattress admits of being withdrawn, and a tin receptacle is placed for the reception of what is voided from the bowels and bladder. Some other advantages of this apparatus will be hereafter briefly mentioned.

With respect to external applications, we should carefully avoid using all such plasters and ointments as irritate the skin, or create a disagreeable itching; for they sometimes bring on erysipelas. The emplastrum saponis in common use is the best for all simple fractures, and it is the best, rather because it does no harm, than because it does any essential good. In some cases, and especially in summer, it is a good plan for the first few days to wet the bandages with cold water; for in this way, the tendency to inflammation and swelling may be considerably lessened. The surgeon, however, should recollect, that the bandage shrinks when wet, and may become so tight as to do harm, if not attended to. Solutions of the acetate of lead make the bandages stiff and hard; and as they are perhaps not more efficacious than cold water alone, the latter is sometimes preferred.

When a fracture is well set, the position of the part right, and the bandage and splints neither too tight, nor too slack, the less the broken bone is moved, and the less the apparatus and dressings are disturbed, the better. Sometimes, however, the practitioner is obliged to take off the splints, and undo the bandage, in order to ascertain that the ends of the fracture lie in even contact. Were he to leave the splints on the part too long, without ever being sure of this important point, he might find, when too late for alteration, that the fracture was in a state of displacement, and the limb seriously deformed. Hence, one reason for employing the eighteen-tailed bandage, or an apparatus, like that of M'Intyre's, which admits of being opened, without disturbing the limb, or even without lifting it from the surface upon which it has been deposited.

In fractures of the lower extremities, particularly of the legs, it sometimes happens, the first two or three nights after the reduction, that the limb is affected with spasms, which displace the ends of the bone. Here, if the patient be young and strong, let blood be taken from the arm, the bowels be emptied, and opium, or morphia prescribed; strict attention being also paid to restore the ends of the fracture to a right position again. If they cannot be kept in exactly a good posture at first, they will admit of being so, after a few days, when the tendency to spasm has diminished.

When the callus has acquired some firmness, the patient should still keep the part or limb quiet, until the union is perfectly consolidated. And, in fractures of the lower extremity, even after the union has proceeded so far, that the splints admit of being left off, the patient ought not to venture to get out of bed, or bear upon the limb, till several more days have elapsed.

All fractures, however simple and well treated they may be, are constantly followed by weakness and stiffness of the limb. These unpleasant consequences are the greater, the more violently the limb has been contused, the nearer the fracture is to a joint, and the longer the part has remained motionless, and without exercise. The stiffness always affects the inferior joint of the broken bone, much more than the superior. For the relief of these effects of fractures, it is customary to employ friction, liniments, emollient applications, cold washes and bathing; but, sometimes, notwithstanding such remedies, the member does not quickly recover its strength, but continues stiff and weak for a year, or even a longer time. The most effectual plans for the prevention of this state should therefore be resorted to early. These consist in making the joints nearest the fracture execute slight motions, as soon as the union is sufficiently advanced, not to be in danger of interruption from this practice. A great deal of caution, however, is necessary in moving the part, and it is safer for the surgeon to superintend the business himself, than leave it to the patient, or others. One of the best proceedings also for the hinderance of much weakness and stiffness in the limb after a fracture, is to discontinue the splints and tight bandages, immediately the state of the callus will allow. The manner in which their pressure retards the circulation, and prevents the action of the muscles, is one of the principal causes of the stiffness of the limb, and, consequently, the sooner they can be safely left off, the sooner will the patient regain the free use of the limb.

In France, the chief division of fractures is into *simple* and *complicated*, which last includes, amongst many varieties, the cases which we name *compound*. We shall here briefly notice a few of the complications, and the particular treatment which they require.

Fractures (says Boyer) are always attended with a certain degree of contusion, which is constantly more severe in cases where the violence has acted directly on the situation of the fracture. But such contusion can only be regarded as a complication of the accident, when it exists in so violent a degree as to demand a different treatment from that which is employed in simple fractures.

In this circumstance, the splints and bandage should be applied rather slackly, and the latter ought to be wet with cold water, or some resolvent lotion. The patient is to be bled more or less freely, according to his age, the state of his constitution, and violence of the contusion. The next day, the splints and bandage should be opened; a thing highly necessary to be observed; for where it has been neglected, the limb has been known to mortify, in consequence of the swelling having rendered the bandage too tight. (*Boyer, Mal. Chir.* t. iii. p. 63, 64.)

In simple fractures, it does not often happen, that a large artery is wounded; but when the injury does occur, and a diffused aneurism takes place, the surgeon is to expose the vessel by an incision, and apply a ligature above and below the opening. We are to be careful, however, before resorting to the operation, that the tumour is not a venous extravasation, which may almost always be dissipated by resolvent applications.

Fractures are sometimes complicated with a dislocation. Here, if possible, the luxation should invariably be reduced before the fracture is set. The possibility of reducing the dislocation (says Boyer) depends upon the species of articulation, the situation of the fracture, and other circumstances of the case. When it is a ginglymoid joint, when the ligaments are lacerated, and the swelling is not considerable, the luxation may be reduced easily enough; but when it is an orbicular joint, surrounded by numerous muscles, and when the fracture is near the articulation, and situated below the dislocation, the reduction of the latter is impossible. The attempt, indeed, would be injurious, because the necessary extension could not act upon the upper fragment; and were it to operate upon the lower, it could only have the effect of painfully stretching the muscles, and perhaps lacerating them. The fracture, therefore, should be at first attended to, and after its firm union, an endeavour may be made to rectify the dislocation. Boyer conceives, that there will be more probability of success, when care is taken to move the limb gently, as soon as the state of the callus will permit it. He also recommends the employment of emollient relaxing applications. He confesses, however, that the attempt rarely succeeds after the perfect union of the fracture. There are, it is true, examples, in which old dislocations may be reduced; but these are cases which are not complicated with a fracture; an accident which always renders the muscles and ligaments so stiff, that they cannot yield to the extension requisite for the reduction. "I do not know (says Boyer) that a luxation, complicated with fracture, has ever been reduced, when the nature of the joint, and the circumstances of the case, prevented the treatment from beginning with the reduction of dislocation." (*Mal. Chir.* t. iii. p. 79.)

Compound Fractures.

Here the first question is, whether an attempt should be made to save the limb? If the first opportunity of amputating be lost, there may *never* be another. *Inflammation* comes on, and the constitutional disturbance may prove fatal, and no second opportunity may present itself. In some cases, traumatic gangrene will invade the limb, and hardly leave time for the surgeon to amputate. Indeed, after it has once begun, so rapid is its progress, that unless the operation be immediately performed, the patient's doom is sealed. Hence, in this kind of mortification, it is now a maxim not to wait for the red line of demarcation, but to remove the limb without the least delay, even though the mortification may be in a spreading state. With the exception of this case, if the first opportunity of amputating has been lost, the surgeon must wait until the constitutional disturbance has partly *subsided*, before the knife can be used. This period may occur on the establishment of suppuration. But whether he ought now to amputate or not, will depend upon the extent and nature of the local injury; whether the soft parts are severely contused and lacerated—the bones crushed and comminuted—the degree of suppuration—the state of the pulse, &c. Under doubtful circumstances, the surgeon may yet be disposed to persevere in his endeavour to save the limb, and sometimes ultimately succeed in bringing the patient through all dangers; in extricating him from the weakening effects of repeated abscesses, profuse suppuration, &c. But in other instances, the long continuance of the suppuration—the presence and irritation of dead bone—the diseased state of all the cellular tissue—the implication, perhaps, of a neighbouring joint in the mischief, and the urgency of the hectic disturbance of the system, will compel the surgeon to amputate.

Supposing an attempt is to be made to save the limb, then the first *indication* is to reduce the fracture. For this purpose, lay the limb on the splint or apparatus, with pad, &c., and attend to the relaxation of muscles. When the protruding end of the bone cannot be returned, it is to be sawn off, or the wound enlarged.

When the fracture is *comminuted*, such fragments as are perfectly detached, quite exposed, and near the surface, are to be extracted.

The second *indication* is to bring the sides of the wound together, with an adhesive plaster, or after its edges have been approximated, the wound may be covered with lint, moistened with the blood, as advised by Sir Astley Cooper; and if the wound unite, the compound fracture is at once converted into a simple one. With the view of keeping off inflammation, the bandages may be wetted with cold water.

In all leading points, the treatment of compound fractures is like that of simple, with the exception of measures called for by the wound itself; the higher degree of inflammation; the abscesses; the detached pieces of bone; the splinters, or sequestra; and the more severe constitutional disturbance. The same attention to keeping the ends of the bone in their proper position, and completely at rest, is even more urgently necessary.

As the presence of a suppurating wound, and the frequent formation of matter, render it indispensable to undo the bandage more frequently than in simple fractures, it should always be a maxim *to employ* such *splints*, *bandage*, or *apparatus*, as will admit of this being done, as often as necessary, without any disturbance of the fracture. The frequent occasion to apply leeches, is another circumstance rendering it important to choose an apparatus which will admit of this being done without disturbing the limb.

An apparatus, which will allow the surgeon to get at almost any part of the circumference of the limb, is particularly advantageous. Hence the superiority of M'Intyre's and Greenhow's apparatus, and the use of fracture-boxes.

While inflammation prevails in a high degree in the early stage of the case, the splints should not be tightly applied, and cold evaporating lotions and leeches may now be of great service. Venesection may also be beneficial when the patient is strong and full of blood; and saline purgatives and opium should be given.

One rule is to make early openings for the discharge of abscesses, and to let them be free and depending. Another maxim is to take away *sequestra* as soon as exfoliation is sufficiently advanced.

In tedious severe cases, patients sometimes fall victims to sloughing over the sacrum or trochanters. In the suppurative stage, attended with hectic symptoms, there is an obvious necessity for supporting the constitution, by means of tonics, sulphate of quinine especially, and light nutritious food, and wine. In this stage, opium, pure air, and cleanliness, will be of vast importance.

Of Hemorrhage in Compound Fractures.

Profuse arterial bleeding is chiefly seen in compound fractures of the leg; but it may happen in those of the thigh, or *humerus*. If a wound of the anterior or posterior tibial artery be conjoined with a violent contusion and extensive *laceration of soft parts*, comminution of bone, or long fissures of it extending into, or near the joint, amputation will generally be most prudent. In the opposite circumstances, the wound of the artery is not an adequate ground for removing the limb. In the treatment of such an accident, *pressure* and *cold* applications are inefficient, and it is indispensable to employ the ligature. Then the question is, whether the wounded part of the artery should be exposed and tied, or the *femoral* artery itself taken up.

Dupuytren and Delpech, instead of adding to the mechanical injury of textures, already existing in the fractured part of the limb, advocated and practised the latter measure, with decided success. In this way, the bleeding was commanded without any additional disturbance of the broken part of the limb. If we look over the particulars of cases, where operations were practised to secure the anterior or posterior tibial artery, in compound fractures, we shall find, that the result has commonly been mortification of the limb, and the patient's death. However, if the anterior tibial artery were wounded in the lower third of the leg, where its place is superficial, I think, that the plan of securing it here, would then be preferable to that of taking up the femoral artery.

Of the Formation of Callus, and the Consolidation of Fractures.

In the treatment of fractures, the whole business of the surgeon consists in putting the displaced extremities of the bone into their natural situation again; in keeping them in this position by means of a suitable apparatus; in endeavouring to avert unfavourable symptoms, and in adopting measures for their removal, when they have actually occurred. The consolidation of a broken bone is (strictly speaking) the work of nature, and is effected by a process, to which a good constitution, with as little disturbance of it as possible, is above all things propitious.

The process, alluded to, is that by which the new bone, or the *callus*, as it is termed, which forms the uniting medium, is produced.

Of the Time requisite for the Formation of the Callus, and of Circumstances, which favour, retard, or prevent it.

Surgical writers have been absurdly anxious to specify a determinate space of time, which should be allowed for the formation of the callus, as if this process always went on in different cases with the same uninterrupted regularity. Forty days were often fixed upon as necessary for the purpose. This doctrine is not only false, but dangerous, inasmuch as patients have been thereby induced to suppose themselves cured, before they were so in reality, and have consequently moved about too boldly, and thus run the risk of occasioning deformity, or a new fracture. It is impossible to determine precisely, and in a general way, the period requisite for the cure, because it differs according to a variety of circumstances. When it is stated, that the callus is usually formed between the twentieth and seventieth day, sooner or later, according to the age and constitution of the patient, the thickness of the bone, the weight which it has to support, the state of the patient's health, &c. we are to understand, that the whole of the process of osseous union is not yet effected, and only that the bone has generally attained a sufficient degree of firmness to admit of the apparatus being discontinued.

1. *Age.* Fractures are consolidated, *cæteris paribus*, with more ease and quickness in young subjects, than in adults, or old persons. In general also, the callus forms more speedily in proportion as the individual approaches to infancy. In two children, whose arms had been broken in difficult labours, De la Motte found the humerus united in twelve days, by a very simple apparatus. In fact, at this period of life, every part has a tendency to grow and develop itself, and the vitality of the bones is more active, their vascularity greate, their gelatinous substance more abundant. On the contrary, in advanced age, the parts have lost all disposition to development, the vascularity of the bones is in a great measure obliterated, and (to use the expression of Boyer) their vitality is nearly annihilated under the mass of phosphate of lime, which accumulates in them.

2. *Constitution.* A fracture is united much sooner, in a strong healthy person, than a weak unhealthy subject. Sometimes, the consolidation is prevented by some inexplicable unknown cause, nothing wrong being remarkable either in the constitution, or the part. Ruysch and Van Swieten met with several cases of this kind, in which the patients were apparently quite healthy, and judiciously treated; and there are few surgeons of much experience, who are not acquainted with similar examples.

3. *Thickness of the Bone, and Weight which it has to support.* The bones are thicker and larger, in proportion as they have a greater weight to bear, and as the muscles inserted into them are more powerful. It is observed, *cæteris paribus*, that the larger the bones are, the longer is the time requisite for their union. Thus a broken thigh-bone is longer in growing together again, than a fractured tibia; the tibia longer than the humerus, the bones of the fore-arm, clavicle, ribs, &c.

As it is not till the definitive callus of which I shall hereafter speak, has been formed, that the bone acquires full strength, and a considerable time is necessary for the completion of that callus, the fact teaches us the prudence of never letting the bone be subjected to much violence, or any great efforts made with the limb, while its firmness depends only upon the provisional callus, the formation of which will be presently explained. Hence one reason, why fractures of the arm are sooner cured than those of the tibia, and why six or eight weeks at least are necessary in the treatment of a broken thigh-bone, which of itself has to support in progression all the weight of the trunk.

4. *State of Health.* Fractures unite with more quickness and facility, when the patient enjoys good health. The scurvy has a manifest and powerful effect in retarding the consolidation of fractures, and even in causing the absorption of the callus several years after its formation, so that a bone becomes flexible again at the point, where it was formerly broken. In Lord Anson's Voyage, this phenomenon is particularly recorded. (See p. 142. edit. 15. in 8vo.) Langenbeck is acquainted with several cases, in which the provisional callus at the end of eight weeks became again soft, and the bone flexible, in consequence of the patients being attacked with fevers, or erysipelas. (*Neue Bibl.* b. i. p. 90.) Cancer, lues venerea, and rickets, are also stated by surgical writers to obstruct, and sometimes hinder altogether, the formation of callus.

With respect to the union of broken bones being prevented by disease, Sir Benjamin Brodie believes, that this *may* be the case, where there is an abscess in the bone, a necrosis, or some other conditions. "I know, however," he observes, "that the rule is not *absolute*; for, in a great many instances, where the bone is diseased, it will unite perfectly. I had a patient, who had disease of the bones, whether it arose from syphilis, mercury, or a cachectic state of the constitution, I cannot say; however, some of the bones had nodes upon them, and were very much enlarged. The principal enlargement was in one of the clavicles. There was a portion of this bone enlarged, and much diseased besides. This man, in using his arm, broke the collar-bone, the fracture going through the diseased part. I bound up his arm, and concluded, that there would be no union; but to my surprise, it united quite as soon as ordinary fractures. Women, labouring under cancer of the breast, are very liable to a similar disease of different bones in the body. Sometimes this disease, which is indicated by pains, like those of rheumatism, will affect nearly the whole of the bones, which then become brittle, and very liable to break. I first observed this fact, many years ago, in the case of an old woman, who was dying of cancer, and who, in turning one day in bed, broke the thigh-bone. I concluded that the broken bone would not unite; but, union took place as well as under ordinary circumstances. I attended a lady, two years ago, who had cancer of the breast, and pains in the limbs, indicating cancerous disease of the bones. There was a scirrhous affection of the collar-bone; and one day, in moving her arm, the collar-bone was broken; but, it united, just as if it had been a healthy bone." (Sir *B. Brodie, in Lond. Med. Gaz.* for 1833, 34. p. 56.) The truth of the latter statement has been proved in the case of a woman, with a cancerous breast who has been a patient in the North London Hospital more than once under Mr. Liston, for spontaneous fractures, which have always united again tolerably well. I was once called to a gentleman's coachman in Montague Mews, for a retention of urine, dependent on a cancerous disease of the bladder. A few days afterwards, his thigh-bone broke, as he was turning in bed; and, in the course of another week he died. The *post mortem* examination detected a scirrhous tumour under the periosteum, surrounding the fractured part of the bone; and one of the ribs, which had given way, was similarly encompassed. The history of the case is recorded in the Med. Chir. Trans. vol. xvii. and the specimens are preserved in University College Museum.

Fabricius Hildanus has cited two cases, which tend to prove, that the union of fractures is retarded by pregnancy. (*Cent.* 5. obs. 87. *Cent.* 6. obs. 68.) Alanson has also related a case in which the union, which had been delayed during pregnancy, took place after delivery; (*Med. Obs. and Inq.* vol. iv. No. 37.) and Werner has published an account of a fracture of the radius in a pregnant woman, where the cure was apparently retarded for a long time by this circumstance, and though the union took place previously to delivery, the callus was not very firm till after that event. (*Richter, Bibl.* b. xi. p. 591.) From facts, however, mentioned in a preceding page, there can now be no doubt, that pregnancy frequently does not prevent the formation of callus in the ordinary time, though the observation of Mr. Wardrop is true, that many instances have been observed of bones fractured during pregnancy, never showing any disposition to unite till after delivery. (*Med. Chir. Trans.* vol. v. p. 359.)

Besides the remarks, made here and in a foregoing page on the causes preventing the union of fractures, a few additional observations on the same subject will be introduced in the sequel of this article, when I speak of the modes of attempting the cure of old disunited fractures.

Of some Circumstances necessary for the Consolidation of Fractures.

Three local circumstances were insisted upon by Boyer, as necessary to obtain a firm callus, without deformity. 1. The two fragments must be possessed of sufficient vascularity. 2. The surfaces of the fracture must correspond. 3. They must be kept in a completely motionless state.

The two fragments must be sufficiently vascular. If one of them should be too scantily supplied with blood, the fracture would be incapable of union. This is what may happen in certain fractures of the neck of the femur, where the head of this bone is entirely detached, and the ligamentous substance, which is reflected over its neck, and serves as its periosteum, is totally lacerated, as well as the vessels, which ramify upon it. Hence, the upper fragment, lodged in the cotyloid cavity, may no longer receive from the vessels, sent to it through the ligamentum teres, a sufficiency of blood for the formation of callus, with any degree of certainty. This is especially likely to be the case, when the patient is far advanced in years, and the vessels considerably lessened in diameter. An adequate circulation must exist in both portions of bone; for, without it, the attempt at union will fail.

The surfaces of the fracture must correspond. This circumstance is not absolutely necessary for the consolidation of the fracture; but, without it, the formation of the callus will be slow and irregular. For instance, in a transverse fracture of the thigh-bone, the fragments, after being displaced according to the thickness of the bone, may undergo a second displacement according to its length, by passing beyond each other. The surfaces of the fracture are then not at all in contact, and the portions of bone only touch each other by their sides. Here, at the end of the second month, the union will frequently have made but little progress; nor can the cure be accomplished without deformity and shortening of the limb.

The fragments must be retained in a motionless state. This condition is so essential to the formation of callus, that, if the ends of a fracture were daily moved, they could not unite. The two extremities of the bone would then heal separately, just like the sides of a wound which have not been put in contact. The ends of a fracture, however, which cicatrize separately do not (according to Boyer) always become smooth, nor is there ordinarily any capsular ligament. (*Mal. Chir.* t. iii. p. 86.)

Of the Formation of Callus.

Perhaps no subject has excited more discussion, than the formation of callus. The ancients ascribed it to the extravasation of a gelatinous fluid, which was called the osseous juice, and which, becoming hard, served to unite the ends of the broken bone, just as glue serves to unite two pieces of wood. Hence, in order to favour the production of callus, they were in the habit of recommending their patients to eat abundantly of every sort of viscid farinaceous aliment, the glutinous parts of animals, and especially osteocolla, of which Fabricius Hildanus relates miracles.

But, if these accounts were true, callus must be inorganic; or else one would be compelled to admit, that the inspissation of an inorganic fluid was capable of producing an organised substance; which is an absurdity. Besides, observation demonstrates, that callus is an organised matter, like the substance of bone itself.

According to Duhamel, callus is formed by the periosteum, which he regards as the organ of ossification. When a bone is fractured (says this naturalist), the periosteum of the two fragments first grows together, and then swells, and forms a circular rising round the fracture. The thickened membrane is converted into a gelatinous substance, which soon becomes a cartilaginous matter. In this vessels are developed, and different points of ossification commence, which multiply and unite. Thus, when every part of the periosteum near the fracture is hardened and ossified, *this membrane is changed, as it were, into a sort of clasp, which extends over the two fragments, and holds them together.*

It was objected to Duhamel's theory, that, if a bone be slit longitudinally in the situation of a former fracture, the fragments are observed to have their substances blended completely together, and not simply to lie in contact in the manner of two pieces of wood placed end to end, and kept in contact by means of a clasp. Duhamel, with the view of obviating this difficulty, supposed that the periosteum elongated itself from the circumference towards the centre of the bone, and that such continuation of this membrane underwent the same changes, as that portion which was contiguous to the fracture, and thus served to unite the ends of the fragments between which it was interposed. He admits, also, in some cases, that the *internal periosteum*, or *medullary membrane, may furnish productions extending between the ends of the fracture,* like the continuation of the external periosteum with which they become connected. Lastly, he supposed, that, in young subjects, whose bones had not acquired their full degree of hardness, the cartilaginous part was capable of extension, and that, in cases of fracture, it contributed to the more perfect union of the fragments.

The system of Duhamel was opposed by Haller and Dethleef, who, after a long series of experiments, came to the conclusion, that callus is formed by a gelatinous juice, which exudes from the extremity of the fractured bone, particularly from the medullary texture, and is effused all about the fracture; that such juice is organised, forms a cartilage, and at length ossifies.

But, whatever difference there may seem to be betwixt this doctrine, and that of Duhamel, it appeared to Boyer to be merely in the mode of explaining the facts. All these observers noticed the same phenomena; and all the experiments of Dethleef accorded perfectly well with those of Duhamel. Both found, during the first days, immediately after the fracture, blood and lymph extravasated between the fragments, and a small tumour in the situation of the fracture. Both also remarked, that this tumour became softer, and that it afterwards formed a gelatinous, then a cartilaginous, and lastly, a bony substance, which composed the uniting medium. But Duhamel contends, that the cartilage is produced by the periosteum, while Haller and Dethleef argue, that it is the production of the extravasated lymph.

Boyer thinks, that Duhamel imputes too much to the periosteum; but, that Haller and Dethleef were also wrong, if they supposed that an unorganised lymph could produce an organised substance by inspissation. (See *Le second Mémoire sur les Os, par M. Bordenave, recueilli et publié par M. Fougeroux*, p. 124.) It appears to Boyer much more natural to believe, that the gelatinous lymph already contains the rudiments of organisation, which become visible as they are developed; just as it is usually believed, that the rudiments of all our organs are contained in the transparent mucilage, of which the embryo seems to consist.

The experiments of Duhamel and Dethleef were carefully repeated by Bordenave, who ascertained several new and interesting facts. The result was the same in regard to the phenomena observed; but the explanation of them was different.

Instead of attributing the formation of callus to the periosteum, like Duhamel; or to the extravasation of lymph, or fibrine, like Dethleef; Bordenave conceived, that broken bones unite again by a process analogous to that which nature employs for the union of the divided soft parts. His inference is principally founded on two facts generally admitted. 1st, That there is in the bones a vascular texture, designed to maintain the circulation in them. 2dly, That such texture dilates when fractures are uniting, as appears from the swelling in the situation of the fracture, without which swelling there could be no union. Bordenave further remarks, with Haller and Dethleef; 1st, That callus, at the commencement of its formation, appears to consist of a glutinous fluid effused from the ruptured vessels. 2dly, That this substance afterwards assumes the form of cartilage, to which certain vessels are distributed, which deposit the bony matter, and thus begin the generation of callus. 3dly, That the particles of bone, being all joined together, the callus changes into a porous substance, which in time becomes solid and compact, like the substance of bones.

John Hunter explained the formation of callus by the organisation of the extravasated blood, and its subsequent ossification. He noticed also the inflammation of the extremities of the bone, the softening and rounding of them, and the partial absorption of their earthy particles.

According to Mr. Howship, the first effect of fracture is the extravasation of blood between the fragments into the medullary cavity, and also into the periosteum, which is thus thickened. The blood coagulates, loses its colouring matter, becomes organised, assumes the appearance of cartilage, and is at length converted into bone. This latter change is first effected external to the fragments, and in the medullary canal, so that an osseous case is formed before the complete reunion of the fracture. (See *Med. Chir. Trans.* vols. vi., vii., and viii., and *G. Gulliver*, in *Edinb. Med. and Surg. Jour. for July* 1835. p. 44.) Mr. Howship's observations are interesting, as coinciding very much with those previously made by Duhamel, Villermé, Breschet, and Dupuytren.

John Bell looked upon callus as a regeneration of bone, organised by the same action as that by which the original bone is formed. "It would appear, that this author had remarked the effusion of blood, and condensation of the soft parts at an early period, so as to form a sort of capsule around the fracture; for, Mr. Liston possesses a large drawing by Mr. Bell, in which these circumstances are clearly marked in a fractured femur." (*G. Gulliver*, *Op.* cit.) This drawing which as Mr. Gulliver states, is in the peculiar graphic style of Mr. Bell, I had an opportunity some time ago of showing to the surgical class of University College, London.

Troja had seen the extremities of a fractured bone covered in a few days with gelatinous matter, which was gradually converted into cartilage, and then into bone. He had also noticed the swelling of the periosteum to a certain period, and the subsequent diminution of its thickness, as well as the obliteration of the medullary cavity, near the fracture, by osseous matter.

The observations, made by Baron Larrey, lead him to reject, as erroneous, the doctrine, which refers the production of callus to the periosteum, and he adopts the opinion, that the union and reparation of bones are the work of their own vessels. He adverts to examples in which, after the use of the trephine in young subjects, the perforation becomes more or less closed by new bone, thrown out from the circumference towards the centre. Here, says he, the ossification assuredly can neither be referred to the pericranium, nor the dura mater. The first of these membranes has been extensively destroyed, and, if the second were concerned, a vertical substance, shutting up the opening, would be apparent. In further support of his opinions, Baron Larrey cites the well-known celerity with which fractures of the lower jaw unite, on account of the great vascularity of that bone; and he believes, with Sir Astley Cooper, that, if the ends of a fracture do not touch, in consequence of loss of substance, the intervening space remains unfilled up by new bone; a position, which seems rather repugnant to what he has said, concerning the mode of reparation after the use of the trephine.

With respect to the alleged impossibility of union, when fractures are attended with loss of substance, Mr. Gulliver observes, that the union of bone, under such circumstances, is common in the lower animals, and has been repeatedly observed in the human subject, of which a remarkable instance is recorded by M. Contevoz. (*Mem. de l'Acad. de Chir.*) "Professor Syme showed me a case in the Royal Infirmary of Edinburgh, in which he had removed from the tibia of an adult male about an inch of the entire diameter of the bone, which had been completely reproduced; and I saw in the practice of Dr. Bushe of New York, a similar example in the femur of a young man, which was not followed by a shortening of the limb equal to the length of that portion of the shaft of the bone removed by Dr. Bushe." (*Gulliver, in Edinb. Med. Journ.* No. 124. p. 46.) If any doubt could exist on this point, it would cease on our remembering the occasional cures of disunited fractures, effected by sawing off the ends of the bone.

Larrey has often seen the superficial layers of the tibia exfoliate, after a necrosis produced by a cause which had destroyed the whole of the periosteum on the front surface of that bone, as is sometimes the case in hospital gangrene. He has seen these layers replaced by red vascular granulations, disposed in parallel lines, which granulations soon ossified, that is to say, phosphate of lime was substituted for the vermilion colour of the vessels, and gave the new-formed substance the appearance and consistence of bone. Lastly, this substance was covered with a new cellular membrane, derived from the adjacent textures; but, in the place of the cicatrix, a depression always remained, proportioned to the loss of substance. If the formation of callus depended on the periosteum, Larrey argues, that the broken patella could never unite by bone, as it is often found to do, when the fragments are kept closely in contact. Here he contends, that the union is brought about by the action and inosculation of the vessels belonging to the substance of the fragments themselves. Lastly, he adverts to preparations, in which the vessels of callus were successfully injected by the celebrated Soemmering. (See *Journ. Complém. du Dict. des Sciences Méd.* t. viii, p. 107, &c. 8vo. Paris, 1820.)

Mr. Liston, formerly, coincided very much with Larrey. "To the surrounding soft parts (says he) has been attributed a great share of the work in the union of broken bones; and when bones have been fractured in circumstances not admitting of this assistance, the process of separation, it is said, cannot be accomplished. In dissecting a fractured limb, which has been removed during the process of union by callus, it will be found, that *the new bone is uniformly attached to the sound part of the old*, the vessels of the part employed in this process being much increased in size; *the newly deposited bone, which in its turn carries on the process, being perforated by numerous and large foramina, for the entrance of corresponding ramifications of arteries. The new formation will be perceived shooting from the opposed ends till these are united;* and the masses, in which they are deposited, will be direct, and but slightly prominent, or, on the other hand, irregular and unshapely, according as the separated ends are favourably or unfavourably placed. I can conceive it possible (says Mr. Liston), and, in fact, have frequently found new bone connected with the soft parts; but, this was the produce of a splinter which had still retained its vitality, and *whose vessels* had formed a contribution to the general action. Great powers, not only in the production, but also in the removal of bone, have been long allowed to the periosteum. No one, I will venture to say, has as yet detected this membrane in either of these acts. *New bone has not been found adhering to the periosteum, either in fractures or necrosis;* far less has a complete substitute, composed of the ossified periosteum, been ever discovered enclosing a sequestrum. In every instance, the new formation is deposited in nodules, adhering firmly to the old bone, and, as remarked above, freely perforated by nutritious arteries. The vessels of the bone, no doubt, are ramified on the external and internal periosteum; but it is only after their entrance into the perforations, that they become disposed to pour out ossific matter." (*Edin. Med. and Surg. Journ.* No. 78. p. 47.)

On this part of the subject, Mr. Gulliver informs us, that he has had frequent opportunities of seeing the new bone in the dense cartilaginiform substance, surrounding the fracture, at an early period; and, "in some of these examples, the new formation might easily be turned off from the old bone without injury to the texture of the latter.

Mr. Syme possesses a fracture of the lower third of the femur, presenting numerous bony points in the dense substance around the injury, which have no connection with the old bone; and Mr. Liston very candidly showed me a fractured tibia, in which he had turned off a portion of new bone with the periosteum. Mr. Howship describes and figures a cartilaginous state of the periosteum, in which there was ossific deposit in the fracture of one of the lower animals, and he refers to Mr. Heaviside's Museum for similar examples in the human subject, which appear to be conclusive. In fractures of the bones of rabbits, I have frequently seen the thickened and indurated periosteum the seat of ossific deposit, while the contiguous cellular texture became gradually condensed around the fracture. It appears indeed, that the fibrous and cellular tissues are of great importance in the reparation of fractures, and that the preliminary steps in the process are mainly dependent on these structures." (*G. Gulliver in Edinb. Med. and Surg. Journ.* No. 124. p. 53.) This is the doctrine of Andral, Dupuytren, and Cruveilhier, the latter of whom gives the case of a reparation of fractured spine, where the vessels of the contiguous fibrous textures had evidently contributed greatly to the work of ossification. (See *Anat. Pathol. Livr.* iv. pl. 4.)

For the most complete account of the process, by which broken bones unite, we are indebted principally to M. M. Villermé, Breschet, Sanson, Cruveilhier, and Dupuytren, all of whom, however, owe a great deal to their predecessors in the same field of inquiry, more especially to Duhamel. In 1808 Baron Dupuytren instituted certain experiments to determine the truth of the statements, made on this subject by Bordenave and Bichat, but was surprised to find nothing to justify their accounts, and he was led to adopt other views, partly founded, however, on those of Duhamel. The process is far more complicated, than represented by Bordenave and Hunter. Many years ago, Sir Benjamin Brodie also made experiments upon animals, with the view of elucidating this subject, and the preparations are still preserved. At that time he thought of publishing a paper on the union of fractures; but, before his investigations were completed, he found the whole matter so satisfactorily made out by Baron Dupuytren, that he was induced to relinquish the design. (See *London Med. Gaz. for* 1833-34. p. 54.) The results of Mr. Bransby Cooper's experiments seem also to agree very much with those arrived at by Dupuytren, due allowance being made for the greater celerity of the process in the bones of rabbits, than in those of the adult human subject. (See *Guy's Hospital Reports*, part 4.) The researches of M. M. Villermé, Dupuytren, and Breschet prove, that all the old descriptions of the process were too limited and exclusive. When a bone is broken, the soft parts near it are torn and contused, and the vessels of these, as well as of the periosteum and medullary membrane, assist in the reparation. It has long been familiarly known, that callus is not formed suddenly; that it requires more or less time for its production; and that the broken part of the bone only obtains solidity by degrees. Now, before the work of repair is complete, several changes happen, one after another, or in succession. Hence, the process is now usually divided by pathologists into four stages.

In the *first*, comprising a period of about ten days from the time when the accident took place, if the injured parts are examined, blood is found to be extravasated around the ends of the fracture, between them, and even in the medullary canal. The ecchymosis may extend to parts far from the fracture. Considerable inflammation and swelling ensue at the irritated points. The muscular fibres are confounded with the inflamed cellular tissue, and very soon cannot be distinguished from other parts. The periosteum becomes red, swollen, and softened, and a reddish serous fluid is effused between it and the portions of the bone, which it covers. The fibrous appearance of the ends of the bone disappears. The medullary membrane itself swells, inflames, and gradually obliterates the tube in the centre of the bone. The medulla acquires a greater consistence, and the portion of it in one fragment is conjoined with that of the other. If we look at what is passing between the ends of the fracture, we find, that the coagulated blood between them is absorbed in a few days, and replaced by a gelatinous fluid; and, between the fourth and the sixth day, the surfaces of the fracture are sometimes, but not always, covered by a reddish, fleecy substance. (See *Dupuytren, Clinique. Chir.* t. iv. p. 132.

In the *second stage*, extending from the tenth to the twenty-fifth day, the swelling of the soft parts becomes firmer, and every day more intimately adherent to the substance between the ends of the fracture; and the muscles resume their usual appearance. This *tumour of the callus*, as it is termed by Baron Dupuytren, now diminishes in extent, and becomes more distinct from the surrounding parts. Its texture is homogeneous, very like fibro-cartilage, and divided with difficulty. Its fibres are parallel to the axis of the bone. The swollen medullary membrane, transformed into a fibro-cartilaginous texture, progressively lessens the central cavity of the bone, and at length fills it up. The internal production, or peg (*cheville*) resulting from these organic changes, becomes blended, on the level of the fracture, with the substance interposed between the fragments. (See *Dupuytren, Op. et.* t. cit. p. 133.)

As the formation of the callus advances, other particularities are noticed, and these occur in what may be considered as the *third stage*, which begins about the twenty-fifth day, and is prolonged to the fortieth, or even the sixtieth. In weak constitutions, the process is not finished till the end of the third month. The firm, homogeneous, fibrous mass, constituting what Dupuytren names, the *tumour of the callus*, acquires by degrees a cartilaginous, and rather an osseous consistence. About the end of this period, the fragments are placed in the centre of a solid ferule, which adheres to every point of their circumference. This kind of ferule, or clasp, the very same thing which was accurately described by Duhamel, is covered by thickened periosteum, which is united to that which invests the sound portions of the bone, and no external traces remain of the solution of continuity. The surrounding cellular tissue is yet stiff and indurated. The soft substance between the fragments has become denser and more adherent to the extremities of the bone; but it is still far from uniting them with any degree of perfection. The central peg, continuing to extend itself towards the ends of the fracture, rapidly assumes a greater consistence, and soon forms a very solid osseous cylinder. It is commonly at this period, that surgeons discontinue the apparatus; but the callus, now existing, is not to remain, and consequently Baron Dupuytren terms it the *provisional callus.*

Fourth stage. Between the third and the fifth, or sixth month, the tumour of the callus becomes gradually more compact; and the central ossification, or peg (*cheville*) undergoes the same transformation. The substance, interposed between the fragments, acquires all the organic characters, and the consistence of the firm substance of bone, from which it is only distinguishable by its particular colour. It is this intervening substance, transformed into an osseous tissue, which makes what Baron Dupuytren has named the *definitive callus.*

Finally, the central ossification (*la cheville*) assumes a lighter texture, cells are produced within it, and, after having been converted into a reticular texture, it disappears, leaving the central canal of the bone perfectly free again. After the restoration of the medullary canal, a medullary membrane, which invests the cells, becomes continuous with the membrane that lines it and secretes the medulla. Lastly, the external portion of the provisional callus, (for the central ossification may be looked upon as another part of it) disappears.

As Dupuytren further explains, the differences of fractures must occasion slight varieties in the formation of the callus. Thus, when the two ends of the fracture pass over one another, the internal cylindrical ossification, or peg, is not formed; and the case is the same, when the bone does not present a medullary canal.

This history of the process, by which fractures unite, must at once let us understand, that the period of forty days, sometimes specified as the time requisite for the consolidation, is far from being sufficient, and that it should be much longer in oblique fractures, and those where the ends of the bone ride over one another.

The same history would lead us to expect what certain facts prove, that, down to a certain period, when a fracture has united with much deformity of the limb, the surgeon may safely make the callus yield, so as to bring the limb into a better shape. Dupuytren has recorded cases, in which he accomplished this purpose in the leg, after the twenty-ninth and even the fifty-ninth day, and in which, a deviation of the hand towards the radial side of the fore-arm was rectified as late as the twenty-fifth day. The advantage, now spoken of, may be obtained without breaking the callus, which is a substance endued with a certain degree of suppleness and elasticity. The fragments having been brought into a better position by the observance of the principles, recommended to be attended to in the reduction of fractures generally, the improved situation of the fragments is to be secured by mechanical means. Thus, as Dupuytren remarks, supposing there is a projection made by the end of one, or those of both fragments, the limb is to be placed between two inflexible planes, which compress it in two diametrically opposite directions. As the projecting points receive the greatest pressure, they tend to return to the level of the rest of the bone. If, by means of pads, the projection is increased, while a vacancy is left at the opposite point, then the effects produced will be still more marked, and even carried so far as to cause deformity in the other direction. The same improvement may be brought about, even without acting directly on the seat of the fracture, by employing the lower fragment as a lever, and applying an apparatus, calculated to incline it in the direction, that will bring it into a better position, with respect to the upper fragment. (*Dupuytren, Clin. Chir.* t. iv. p. 147.) The apparatus should be put on more tightly, than in a recent stage of fracture; but the manner, in which the limb bears the pressure must be vigilantly attended to. So long as the deformity is not entirely corrected, the apparatus should be opened every third, or fourth day, and fresh, but gentle, attempts at reduction made. Every little improvement made by each manual interference, is then to be secured by means of the bandage and apparatus. In this way, the natural shape of the limb will be gradually restored. The plan is not, however, to be continued too long, as it would altogether prevent union of the bone. Another maxim, laid down by Dupuytren, is, that, when the deformity has been considerable, the treatment after its removal, should be continued as long as if the case were a recent fracture. (*Clin. Chir.* t. iv. p. 146—151.)

The *provisional callus* then differs from the definitive, not only in point of situation, and time of its formation, and continuance, but in its inferior consistence and solidity. When completed, it only possesses the strength necessary to resist the moderate action of the muscles, and to support a certain weight. Nay, after the removal of the splints, it will sometimes yield to these forces, especially in oblique fractures. In the North London Hospital, I have now (April 1837) a patient, whose thigh was obliquely fractured in its upper third on the 1st of last October. After the limb had been kept in splints three months, and seemingly united well and without deformity, the apparatus was discontinued; but the mere action of the muscles, as the man lay in bed, produced a retraction of the limb three days afterwards. The fracture was then set again, and in another three months, union was again completed, and the apparatus removed. In four or five days, the callus yielded again, and now the fracture has been set for the third time.

The support of the provisional callus is frequently overcome by a blow, or rough use of the limb. Sometimes, it is weakened, or destroyed by the influence of constitutional diseases, fever, &c.

The *definitive* callus, though less bulky, is harder, stronger, and more compact, than the *provisional.* Hence, after the definitive callus has been completed, bones rarely, or never break in the exact situation of the former fracture. Excepting in very aggravated forms of scurvy, I believe, that the definitive callus is hardly ever disorganised and destroyed by the effects of constitutional diseases.

When the two ends of a fracture are in contact only at a point, it is here alone that the definitive callus can be produced; but, as a compensation, the external, or provisional callus is then never entirely absorbed.

In fracture of the neck of the thigh-bone, entirely within the capsular ligament, the provisional callus cannot reach the fracture, and, if bony union follow, it is effected by a process within the bone itself. "The instances, (says Mr. Mayo) in which union is effected through a process, originating in the bone itself, are fractures of the cranium, and of the neck of the thigh-bone, within the capsular ligament. In the first of these cases, no provisional callus is formed; in the second, the provisional callus has no means of reaching the fracture. It is difficult to explain why a provisional callus does not form about fractures of the cranial bones. The physical cause of this negative phenomenon is not known. The final cause, however, is evident. If a hard swelling, such as a provisional callus, were stretched, as a ridge along the inner aspect of a cranial fracture, it would encroach upon the cranial cavity; and hemiplegia, epilepsy, or some other form of cerebral disorder would attend the cure of every fracture of the skull. No callus therefore is formed. But the fracture, after a time, shows a disposition to unite through forces inherent in the bone itself, &c. In a fissure of the skull, examined some months after the injury, the only change apparent is the rounding of the edges externally. After a year or two, the fissure is united at its internal or cerebral aspect. After the lapse of many years, the narrowest part of the fissure is entirely filled up. In persons, who have lived ten, twenty, or fifty years, after loss of portions of the cranium, the slow restoration of the bone appears to have been progressive for the whole period. In fifty years, a trephine hole is nearly closed by the shelving growth of bone from the margin towards the centre." (See *Mayo's Outlines of Human Pathology*, p. 8.) The causes of the difficulty of bringing about osseous union in such fractures of the neck of the femur, as are entirely within the capsular ligament, will be hereafter considered.

When the ends of a fracture only touch laterally, as I have stated, there is strictly no provisional callus. The vessels of the adjoining cellular tissue, muscles, and other textures, here greatly assist in the work of reparation. The side of one fragment becomes soldered to that of the other, and here the callus is permanent, or never removed. In such a case, there is no internal cylindrical ossification; no *cheville*, as the French term it; because it would evidently be of no service.

In compound fractures, followed by suppuration, the bones remain disunited for many weeks. Here also no provisional callus is formed. The ends of the bones soften and granulate, and, in proportion as the secretion of pus subsides, the granulations begin to deposit the osseous matter, which is to constitute the uniting medium. This part of the subject was explained many years ago by John Hunter, and the late Mr. Wilson. (*On the Skeleton, Diseases of Bones, &c.* p. 233. 8vo., also *Dict. des Sciences Med.* t. xxxviii, p. 486.)

Fractures of the patella, olecranon, condyles of femur, coronoid process of ulna, acromion, and coronoid process of the jaw, are generally united by a ligamentous substance.

Broken cartilage does not unite by cartilage, but by means of osseous matter, deposited around the solution of continuity, in the manner of a provisional callus, which, however, is here permanent.

As the provisional callus in adults never begins to ossify before the tenth day, we know, that, if great inflammation, or other causes, forbid the application of mechanical means during this period, no permanent deformity will be the result of deferring the employment of splints, bandages, &c. On this principle, and, with the view of letting the limb get into a more favourable state to bear the pressure of mechanical means, Sir Stephen Love Hammick does not usually apply any apparatus during this stage. In infancy, however, where the callus is completed with surprising quickness, the surgeon must be careful to set the fracture without delay.

Of the Conduct to be adopted at the ordinary Period of the Consolidation of Fractures; and of Ununited Fractures, and False Joints.

When the requisite time for a broken bone to become firmly united has elapsed, it is proper to examine carefully and cautiously the place of the fracture, in order to learn whether the callus has acquired a suitable degree of strength. If the bone should be found to bend in the least at the injured part, the callus is not sufficiently strong, and the limb should be immediately put up in the apparatus again, with the view of preventing a new fracture, or, at all events, deformity.

For the same reason, the patient should not be allowed to make free use of his limb, as soon as the fracture has united. In fractures of the lower extremity, he ought to use crutches, and only let the weight of the trunk by degrees bear upon the injured limb. From neglect of this precaution, the callus has been known to be absorbed, the limb to be shortened, and the patient become a cripple. An accidental slip may also produce the fracture again; for the provisional callus, so far from being firmer than the rest of the bone, is at first considerably weaker.

That the state of the constitution has vast influence over the process by which broken bones are reunited, is unquestionable. Schmucker found the formation of callus, even in the most simple fractures, sometimes delayed eight months, and, in one example, more than a year; but, all the patients were unhealthy. (*Vermischte Chir. Schriften*, b. i. p. 26.)

There are certain indescribable constitutions, in which bones, particularly the os brachii, will not unite again after being broken. These temperaments are also exceedingly various; at least, I infer so from two subjects, to whom I paid particular attention. One was a strong, robust man, whose chief peculiarity seemed to be his indifference to pain: the ends of his broken humerus were cut down too, turned out, and sawn off by Mr. Long, in St. Bartholomew's Hospital, and the limb was afterwards put in splints, and taken the greatest care of; but no union followed. The other case was a broken tibia and fibula, which remained disunited for about four months; but afterwards grew together. The latter subject was a complete instance of hypochondriasis. I afterwards saw a woman, under Sir James Earle, in the above hospital, whose os brachii did not unite, though it had been broken several months. Every attempt to move the bone occasioned excruciating torture. The woman died of some illness in the hospital, and, on dissecting the arm, the cause of the fracture not having united was found to arise from the upper, sharp, pointed extremity of the lower portion of the broken bone having been forcibly drawn up by the muscles, and penetrated the substance of the biceps, in which it still remained. I am indebted to Mr. Earle for the description of the appearance in the dissection, and I do not know, that this kind of impediment to the union of a fracture has been noticed by any earlier writer than Mr. Charles White, who appears to have conceived the possibility of the occurrence. (*Cases in Surgery*, p. 70. edit. 1770.)

Sir Benjamin Brodie attributes the want of union mostly to the state of the constitution. "A gentleman (says he), was growing fat, and not liking to do so, he placed himself on a very spare diet, though accustomed to good living previously. After six months of starvation, he broke his arm, and the bone would not unite. I saw him many months afterwards, and there was scarcely any union even by soft substance. Another patient, about whom I was consulted, a lady, was growing fat, and thought she would also prevent it by pursuing a similar system of diet. Some months afterwards she broke her arm, and union did not take place." A man broke his thigh, and remained ten days without any action of the bowels: no union of the fracture ensued. The same distinguished surgeon adverts to other facts, which tend to prove, that tight bandaging, and other circumstances, unfavourable to a free circulation in the limb, may prevent union. (See *Lond. Med. Gaz.* for 1833-34, p. 57.)

It is observed by Larrey, that the gunshot wounds of the extremities, complicated with fracture, especially with that of the humerus, received by the soldiers of the French army in Syria, were almost all followed by the formation of accidental joints. The two fragments of the broken bone continued moveable, their asperities and projecting angles having been destroyed by friction, and their ends being rounded and covered with a cartilaginous substance, so as to facilitate the motions which the patients executed in various directions, in an imperfect manner, and without pain. Larrey acquaints us, that many invalids were sent back to France with such infirmity.

"I ascribe," he says, "the causes of these accidental articulations :

"1. To the continual motion, to which the wounded soldiers were exposed, after their departure from Syria, till their arrival in Egypt, in consequence of their having been obliged either to walk this journey on foot, or to be carried it on beasts.

"2. To the bad quality of the food, and the brackish water, which the men were under the necessity of drinking in this painful journey.

"3. To the state of the atmosphere of Syria, almost entirely destitute of vital air, and impregnated with pernicious gases, issuing from the numerous marshes, near which we were a long while stationed.

"All these causes may have prevented the formation of callus, either by diminishing the quantity of the phosphate of lime, or moving the bones out of that state of coaptation, in which they should constantly lie, in order to unite.

"Bandages, embrocations, rest, and regimen, proved quite ineffectual." (*Larrey, Mém. de Chir. Mil.* t. ii. p. 131, 132. *Langenbeck, N. Bibl.* b. i. p. 81.)

The presence of an ulcer, a sinus, loose splinters of bone, a necrosis, or other suppurating disease, near a fracture, is a circumstance that often seriously retards or completely prevents the formation of callus. How frequently have I noticed, in compound fractures, that, while the wound suppurates largely, and while there are spiculæ and dead portions of bone unextracted, no solid union takes place; but that, as soon as the wound, ulcer, or sinus admits of being healed, and the suppuration ceases, ossification goes on in the most favourable manner. Schmucker relates a case, illustrating the truth of these observations, where the tibia and fibula were broken so obliquely, that the ends of the fracture could not be made to lie well, a necrosis of a portion of the tibia followed, and no callus was formed at the end of eight months, when a sinus on each side of the leg still continued. This eminent surgeon now laid the sinuses open, and extracted the dead pieces of bone, by which means the impediment to the formation of callus was removed, and the fracture, which had till then remained loose and moveable, became firmly united in two months. (*Vermischte Chir. Schriften*, b. i. p. 25, 26.)

A little boy was brought into the North London Hospital, with fracture of the humerus, and extensive laceration of the skin, but the wound had no communication with the fracture. A good deal of suppuration ensued from the wound, and afterwards large abscesses formed, followed by the detachment of a dead portion of bone. The fracture did not unite.

False joints, which occur in cases of fracture without union, have been generally supposed to resemble common joints. According to Boyer, this opinion is incorrect. The ends of the fracture, which are sometimes rounded, and sometimes pointed, are connected together by a cellular and ligamentous substance. But, their surfaces are not covered by a smooth cartilaginous matter, nor is there constantly a capsular ligament. "I am convinced of this fact, by the dissection of several ununited fractures, the fragments of which are preserved in my museum." (*Boyer*, t. iii. p. 94.) And, in another place, the same Professor, speaking of these false joints, remarks: "I repeat that I have never found, in their structure, any thing which could be compared with an articulation; neither capsular ligament, nor smooth cartilaginous surfaces. On the contrary, I have invariably found, in the false joints of the thigh-bone and humerus, which I have had opportunities of dissecting, a fibrous ligamentous substance, extending from one fragment to the other, and it is very probable, that, with some modifications, it is the same with all the other cases, which I have not seen.

"But, in the fore-arm, the ends of the fracture may assume a structure, which bears a greater resemblance to an articulation. This is what happened in an example, which was communicated to Bayle by Sylvestre, in the *République des Lettres, Juillet*, 1685, p. 718, &c. A similar case is recorded by Fabricius Hildanus, *Obs.* 91. *Centur.* 3." (*Boyer, Mal. Chir.* t. iii. p. 101—103.)

On this subject, Langenbeck observes, that the edges of the fragments heal, and resemble those of a hare lip. "When the parts are incessantly moved, the end of one fragment becomes excavated, in the form of an articular cavity. I have in my possession (says he) a lower jaw, and an olecranon, the fractures of which are not united. For the connecting medium, nature has provided a white substance, resembling ligament. In a male patient, I have also seen an articular connection established in the body of the thigh-bone subsequently to a fracture." (*Neue Bibl.* b. i. p. 93.) When a capsule has been formed, it is alleged not to be of a ligamentous nature. (*Bichat, Anatomie Générale*, t. iii. p. 191.)

In the Hunterian Collection may be seen a false joint in the bones of the fore-arm, where the resemblance to a natural articulation was greater, than what Boyer has seen in other situations.

According to Professor Sharpey, the connection is mostly by means of a tough, fibrous, ligamentous-looking mass; and the nearest approximation to a new articulation, which occurs, consists in the existence of cavities, more or less extensive, between the fibres of this connecting substance. (See *Syme's Principles*, ed. ii. p. 161.) The bond of union is stated to differ from ordinary ligament in presenting no fibrous appearance. Sir Benjamin Brodie, who has made this remark, coincides with Boyer, with regard to the ordinary mode of connection; admitting, however, the occasional formation of a new, or false joint, where "the rounded ends of the bones are covered by a thin ligamentous substance, and the inner surface of the capsule is lined by a smooth membrane, like the synovial membrane, and capable of secreting synovia." (See *Lond. Med. Gaz.* for 1833-34, p. 57.)

A valuable dissertation on false joints was published by Reisseisen, entitled "*De Articulationibus analogis, quæ Fracturis Ossium superveniunt.*"

A false joint in the arm, or fore-arm, does not absolutely prevent the motion of the limb, which may yet be of considerable use; but, when the disease is in the thigh or leg, the member cannot support the weight of the body, and the patient is unable to walk without crutches.

The diversity of causes, which may be concerned in preventing the union of fractures, plainly shows, that the treatment should be different in different cases.

When the want of union is ascribable to the ends of the fracture not being in a state of coaptation, and to their having been moved about too frequently, the obvious indications are, to set the fracture better, and to take adequate measures for keeping its extremities in contact and perfectly motionless.

If the union has been prevented by a portion of muscle, or other soft part, getting between the ends of the bone, the only means of affording a chance of union would be cutting through the integuments, removing the displaced soft parts, and placing the ends of the bone in contact. (*Wardrop, in Med. Chir. Trans.* vol. v. p. 363.)

When the advanced age of the patient seems to be the cause of the union not taking place, the application of the proper apparatus is to be continued a considerable time, since experience proves, that, in old subjects, the cure of fractures often requires many months. In such examples, also, tonic and cordial medicines, with a nutritive diet, are highly proper.

Any thing in the state of the constitution, likely to account for the want of union, should be removed or rectified. "One patient may require to be put upon a better diet; another may require purgative medicine; another may stand in need of tonics. Mr. Wilson used to relate the case of a woman who was a dram-drinker, and who broke her leg. At first, she was not allowed to take her customary drams, and the bones showed no disposition to unite. At last, she was allowed to take a certain quantity of spirit, and union took place immediately." (*Brodie, Op.* et vol. cit. p. 58.)

When several months have elapsed since the accident, and there is reason to apprehend that a preternatural joint or a ligamentous union has taken place, a variety of local plans have been proposed.

Here, I may remark, that no severe operation will be justifiable, unless the inconvenience, arising from the want of bony union, be considerable. If a broken rib were not to unite, by osseous matter, it would be of little consequence. I opened an old man, who was in this state, yet he had never complained of it, nor indeed had he ever been aware of it. Sir Benjamin Brodie has a specimen of a joint, formed in a rib after fracture; and the patient was believed to have suffered little or no inconvenience from it. (See *Lond. Med. Gaz.* for 1833-34, p. 58.)

The most ancient method of treatment is that of forcibly rubbing the ends of the fracture against each other, so as to make them inflame, and take on a disposition to form callus. This plan was recommended by the late Mr. John Hunter, and has had the approbation of many other distinguished modern practitioners. In a disunited fracture of the leg or thigh, Mr. Hunter used to let the patient get up, and attempt to walk with the splints on the limb, so that the requisite irritation might be produced. The idea of exciting a degree of inflammation in the situation of the fracture, certainly appears rational, and the practice has been attended with a degree of success. Mr. White records an example, in which he cured a broken thigh on this principle, a strong leather case having been made for the limb. (*Cases in Surgery*, p. 75.) A broken tibia, treated on similar principles, is mentioned by Mr. Amesbury. (*On Fractures*, p. 211. ed. ii.) The method is spoken of in Celsus: *si vetustas occupavit, membrum extendendum est ut aliquid lædatur: ossa inter se manu dimovenda, ut concurrendo exasperentur, et ut si quid pingue est, eradatur, totumque id quasi recens fiat, &c.*

I have seen cases, in which the union was thus brought about. "In numerous instances (says Sir Benjamin Brodie,) I have known patients in the hospital kept in bed for ten weeks, and even longer, without union taking place. A splint has then been bound on each side of the limb; we have put the patient on crutches, made him walk about, put the limb to the ground, and exercise it with the splint on, and the fracture has become united. Then in other cases I have applied blisters to fractures which were slow in uniting": but, if this method is to be useful, it must be tried in eight or ten weeks after the accident. (*Brodie,* in *Med. Gaz.* for 1833-34, p. 58.)

The foregoing treatment, however, is only likely to answer, before a new joint, or a ligamentous connection, has been completely formed, and when the limb has hitherto been kept motionless.

When the case is old, and there are grounds for believing that a new articulation, or ligamentous connection, has taken place, we are advised to cut down to the ends of the bone, rasp or saw them off, and then treat the limb just as if the case were a recent compound fracture.

Sir Everard Home used to mention the case of a man with ununited fracture of the humerus, who was under Mr. Hunter's care. There was an artificial joint, and Mr. Hunter made an incision into it and then having introduced a spatula, he irritated the whole surface of the artificial joint. This brought on considerable inflammation, which ended in anchylosis, and the patient was cured. (*Sir. B. Brodie,* in *Med, Gaz.* for 1833-34, p. 58.)

This bold practice was first suggested by Mr. C. White. "Robert Elliott, of Eyham, in Derbyshire, a very healthful boy, nine years old, had the misfortune, about Midsummer, in the year 1759, by a fall, to fracture the humerus, near the middle of the bone. He was immediately taken to a bone-setter in that neighbourhood, who applied a bandage and splints to his arm, and treated him as properly," says Mr. White, "as I suppose he was capable of, for two or three months. His endeavours, however, were by no means productive of the desired effect, the bones not being at all united. A surgeon of eminence, in Bakewell, was afterwards called in; but as he soon found he could be of no service to him, and as the case was very curious, he advised the lad's friends to send him to the Infirmary at Manchester. He was accordingly brought thither the Christmas following, and admitted an in-patient. Upon examination, we found it to be a simple oblique fracture, and that the ends of the bone rode over each other: his arm was become not only entirely useless, but even a burden to him, and not likely to be otherwise, as there was little probability that it could ever unite, it being now six months since the accident happened.

"Amputation was therefore proposed as the only method of relief: but I could not give my consent to it, for as the boy was young, and had a good constitution, it was hardly possible that it could be owing to any fault in the solids or fluids, but that either nature was disappointed in her work by frequent friction, while the callus was forming, or rather, that the oblique ends of the bone, being sharp, had divided a part of a muscle, and some portion of it had probably insinuated itself betwixt the two ends of the bone, preventing their union. Whichever of these might be the case, I was of opinion," continues Mr. White, "that he might be relieved by the following operation, viz. by making a longitudinal incision down to the bone, by bringing out one of the ends of it, which might be done with great ease, as the arm was flexible, and cutting it off, either by the saw or cutting pincers; then by bringing out the other, and cutting off that likewise, and afterwards by replacing them end to end, and treating the whole as a compound fracture.

"The objections, made by the other gentlemen concerned, to this proposal, were, first, the danger of wounding the humeral artery by the knife; secondly, the laceration of the artery by bringing out the ends of the bones; and, thirdly, that we had no authority for such an operation. As to the first, that was easily obviated, by making the incision on the side of the arm opposite to the humeral artery. The place of election appeared to me to be at the external and lower edge of the deltoid muscle, as the fracture was very near to the insertion of that muscle into the humerus; the danger of wounding the vessel not only being by that means avoided, but, after the operation, while the patient was confined to his bed, the matter would be prevented from lodging, and the wound be easily come at, to renew the dressings. The second objection will not appear to be very great, when we consider that, in compound fractures, the bone is frequently thrust with great violence through the integuments, and seldom attended with laceration of any considerable artery; and as this would be done with great caution, that danger would appear very trifling. The third and last objection is no more than a general one to all improvements.

"This method which I have been proposing," says Mr. White, "was at last resolved upon, and I assisted in the operation, which was performed by a gentleman of great abilities in his profession, on January 3., in the present year (1760). The patient did not lose above a spoonful of blood in the operation, though the tourniquet was not made use of. When the operation and dressings were finished, the limb was placed in a fracture-box, contrived on purpose, the lad confined to his bed, and the rest of the treatment was nothing different from that of a compound fracture.

"The wound was nearly healed in a fortnight's time, when an erysipelas came on, and spread itself all over the arm, attended with some degree of swelling: this, by fomentations, and the antiphlogistic method, soon went off, and the cure proceeded happily, without any other interruption. In about six weeks after the operation, the callus began to form, and is now quite firm. The arm is as long as the other, but somewhat smaller, in consequence of such long-continued bandages: he daily acquires strength in it, and will soon be fit to be discharged." (*Cases in Surgery*, p. 69, &c.)

In another instance of a broken tibia, which continued disunited an extraordinary length of time, Mr. White practised an operation, somewhat similar to the foregoing one, with complete success. He made a longitudinal incision, about four inches in length, through the integuments, which covered the fracture. By the application of a trephine, he cut off the upper end of the bone, and as the lower end could not be easily sawn off, he contented himself with scraping it. In the course of the subsequent treatment, he had occasion to take off, with the cutting pincers, a small angle of tibia, and to touch the lower part of the bone with the butter of antimony, as well as to introduce the same caustic between the extremities of the fracture, in order to destroy a substance, which intervened. A trifling exfoliation followed. In twelve weeks the bone was firmly united. (*Op.* cit. p. 81., 82.)

Besides Mr. White's cases, there are now some other instances upon record, where the operation, which he first proposed, has succeeded. In the year 1813, Langenbeck operated upon a humerus in the foregoing manner, and the result was perfectly successful. The ununited fracture was situated at the insertion of the deltoid. (*Neue Bibl.* b. i. p. 95.) Mr. Rowlands, of Chester, by a similar operation, believed that he had cured a fractured thigh, which had lost all disposition to unite. (See *Med. Chir. Trans.* vol. ii. p. 47.) I understand, however, from Sir Benjamin Brodie, that the subject of this operation lately died, and that on examination of the broken part of the limb, there was no bony union. Viguerie, surgeon to the Hôtel-Dieu, at Toulouse, practised Mr. White's operation with success. (See *Larrey, Mém. de Chir. Militaire*, t. ii. p. 132.)

On the other hand, the operation has frequently failed. In the instance, in which I saw it executed on the humerus by Mr. Long, in St. Bartholomew's Hospital, it did not answer, though the ends of the bone were most fairly sawn off, and the case treated with particular care and skill.

Boyer states, that he once performed the same operation in a similar case; but, that it had not the desired effect. (*Traité des Mal. Chir.* t. iii. p. 110.) Dr. Physick, of New York, when he was a student in 1785, saw this proceeding unsuccessfully adopted in a case where the humerus remained disunited. (See *Medical Repository*, vol. i. *New York*, 1804.) Besides these examples, I have heard of others, in which Mr. Cline, Mr. Green (*Med. Chir. Review, Feb.* 1828; and *Lond. Med. Gazette*, p. 357.), and other practitioners tried the experiment with no better success. What is still more discouraging, the operation has sometimes proved fatal. (*Richerand, Nosogr. Chir.* t. iii. p. 39. ed. 2. *Larrey, Mém. de Chirurgie Militaire*, t. ii. p. 132.)

Baron Dupuytren deemed the removal of one end of the fracture sufficient, and gives two cases, in which the plan succeeded; one of a thigh-bone, the other of a lower jaw. In the latter instance, however, he scraped away the ligamentous texture from the anterior fragment. (See *Journ. Univ. des Sciences Méd.* t. ix. 1820; and *Clin. Chir.* t. iv. p. 667; 8vo. Paris, 1834.)

The difficulties, the danger, and the frequent ill success of White's operation, had rendered another mode of treatment extremely desirable, when Dr. Physick, of New York, suggested the plan of introducing a seton through the preternatural joint, with the view of exciting inflammation, and bringing about the union of the bone. It was, in fact, a practice founded on Hunter's principles. Dr. Physick had an opportunity of performing the new operation on the 18th of December, 1802, in an example of disunited humerus, twenty months after the occurrence of the accident. "Before passing the needle (says Dr. Physick), I desired the assistants to make some extension of the arm, in order that the seton might be introduced, as much as possible, between the ends of the bone. Some lint and a pledget were applied to the orifices made by the seton-needle, and secured by a roller. The patient suffered very little pain from the operation. After a few days, the inflammation (which was not greater than what is commonly excited by a similar operation through the flesh of any other part) was succeeded by a moderate suppuration. The arm was now again extended, and splints applied. The dressings were renewed daily for twelve weeks, during which time no amendment was perceived; but, soon afterwards, the bending of the arm at the fracture was observed not to be so easy as it had been, and the patient complained of much more pain than usual, whenever an attempt was made to bend it at that place. From this time, the formation of the new bony union went on rapidly, and on the 4th of May, 1803, was so perfectly completed, that the patient could move his arm in all directions, as well as before the accident happened. The seton was now removed, and the small sores occasioned by it healed up entirely in a few days. On the 28th of May, 1803, he was discharged from the hospital perfectly well, and he has since repeatedly told me, his arm is as strong as ever it was." (*Physick, in Medical Repository*, vol. i. *New York.*) In the London Medical Repository for Aug. 1823, a case is also noticed, in which Dr. Physick cured an ununited fracture of the lower jaw by means of a seton.

On this subject an interesting memoir was read by Laroche to the Ecole de Médecine at Paris (Germinal, an 13). It was entitled "*Dissertation sur la non-reunion de quelques fractures, et en particulier de celles du bras, et sur un moyen nouveau de guérir les fausses articulations qui en resultent.*" The author of this production affirms, that when he was at Augsberg, he saw Baron Percy, then with the army of the Rhine, pass a seton through the imperfectly healed cicatrix of a compound fracture of the thigh, which fracture seemed to have lost all disposition to unite. The method answered so well, that in two months the patient was able to walk without crutches.

Sir Benjamin Brodie has also successfully employed the seton in a case of ununited broken thigh. The patient was a boy about 13. (See *Med. Chir. Trans.* vol. v. p. 387, &c.) In this country, the same operation has been practised for the cure of a disunited humerus by Mr. Stansfield, of Leeds. (See *Op.* cit. vol. vii. p. 103., &c.) It appears, also, that Sir Charles Bell applied the method to a fracture of the leg, at the time when M. Roux was in England. The patient was a child six years old, and the broken bones had continued without union three years. The case had been originally mistaken by some unskilful surgeon for a mere contusion. The result is not stated. (*Parallèle de la Chir. Angloise, &c.* p. 195.) In the North London Hospital, Mr. Liston lately employed a seton for an ununited fracture of the radius and ulna. The result was successful in reference to the latter bone. After cutting down to the fracture, he destroys the ligamentous connections as much as possible, and then passes the seton, which he takes out again sooner than is usually done. The result of an operation of this kind on the humerus, performed by him on a child in the North London Hospital, about five months ago, I am not at present acquainted with.

We are not to expect, that Dr. Physick's operation will succeed in every instance. Like most other surgical means, it is liable to occasional failures, amongst which, I believe, we must include the attempt, made on a disunited thigh by Mr. Wardrop (see *Med. Chir. Trans.* vol. v. p. 365.) though a partial amendment is mentioned. In a case, recorded by Mr. Amesbury, the seton did not answer. Mr. A. C. Hutchinson was also obliged to take out the seton, in a case of ununited humerus, and only partial benefit was effected. (See *Practical Obs.* p. 389. ed. 2.) Three instances of failure were seen by Mr. Amesbury, (*On Fractures*, p. 224.) and an additional one has been recorded by Mr. Earle. (See *Med. Chir. Trans.* vol. xii. p. 195.)

In the same case, and also in another, which I saw under this gentleman's care, the plan of cutting down to the ends of the fracture, and rubbing them with caustic potassa, was tried, but without success.

The result of the practice with the seton is, that it has sometimes succeeded in the upper extremities; but that, where it has been performed on the lower ones, so far as Sir Benjamin Brodie has been able to ascertain, it has only answered in a single instance, which was that of a patient under him in St. George's hospital. "Dr. Dorsey (who was Dr. Physick's nephew) in the last letter, which I had from him before his death, informed me as the result of the operations with the seton in the United States, that it had generally succeeded in the upper limbs, but that it had always failed in the lower." He added, that, "in the former case, it was often necessary to keep the seton in for several months." (*Op.* and *Vol.* cit.) M. Portal, however, surgeon to the Palermo Hospital, cured by the seton an ununited fracture of the upper third of the femur in a child two years old. (See *Archives Gén. Juillet*, 1835.) An instance of an ununited fracture of the tibia was also successfully treated with a seton by Dr. Browne. (See *Dublin Hospital Reports*, vol. iv. p. 320.) A very similar case was published by Mr. Boggie. (See *Med. Chir. Trans.* vol. vii.) Dr. Mott has treated eleven cases of ununited fractures in this manner. Of these, three were of the femur; three of the tibia, and five of the humerus. In all, the plan is stated to have succeeded perfectly, except in three of the humerus, which were afterwards cured by sawing off the ends of the bones. (*Amer. Journ.*) These results are different from those, which might have been expected from the investigations of Sir Benjamin Brodie, and the statements of others, concerning the success of sawing off the ends of the bone.

Instead of several of the foregoing severe and often unsuccessful plans, Mr. Amesbury has tried, the influence of local pressure and rest. He maintains the ends of the fracture closely pressed together, the pressure, when the fracture is transverse, operating longitudinally, and when oblique, transversely. On this subject, Sir Benjamin Brodie observes, "I do not know, that this firm pressure produces the union of the bone by a process, at all like that which takes place in the first instance after fracture. I think it more likely that it causes the surfaces to grow together without the provisional callus being formed on the outside. However that may be, I know, that, in several cases, it has succeeded. I have attended two cases with Mr. Amesbury in which this plan was adopted, and in which it succeeded perfectly. I had a patient in St. George's Hospital, in whom I tried this method of treatment; and in that case also it succeeded, so that at the end of some weeks, the fractured bone, which had been ununited for many months, became completely consolidated. The pressure must here be considerable, so as to give the patient a good deal of pain, yet not sufficient to do him injury." Sir Benjamin Brodie, however, has known of several cases, in which this method has failed; but notwithstanding this fact, he pronounces it to be on the whole a more successful plan, than any other. A short sling, pads, and a particular apparatus are used accordingly. (*On Fractures*, p. 236.) Mr. Buchanan, of Hull, has related two cases, in which the union of fractures followed a perseverance in the application of tincture of iodine. (*On Diseases of Joints*, p. 75.)

Fractures of the Nasal Bones.

These bones, from their situation, are much exposed to external violence. The fragments may be displaced, or not. In order to replace them, the surgeon must pass a female catheter, a ring-handled forceps, or any such instrument, into the nostrils, and, using it as a lever, push the fragments outwards; while, with the index-finger of the left hand, he prevents them from being pushed out too far. When the fragments are disposed to fall inwards again, some authors advise supporting them with an elastic gum cannula, or lint, introduced into the nostril; but I am inclined to believe with Sir C. Bell, that no tubes can be employed so as to support the broken bones; and when these have been replaced, they will not readily change their position, as they are acted upon by no muscles. (See *Operative Surgery*, t. ii. p. 222.) Besides, as Delpech remarks, since the tubes cannot reach the fragments, they cannot support them, and they must be attended with all the inconvenience of foreign bodies placed in contact with parts already inflamed, or about to become so. (*Précis des Mal. Chir.* t. i. p. 222.)

As fractures of the ossa nasi are the result of falls, and direct blows on the face, the soft parts are always either contused, or wounded. These fractures are sometimes attended with dangerous symptoms; depending either upon the concussion of the brain, produced by the same blow which causes the fracture; or, on the cribriform lamella and the crista galli of the os ethmoides being driven inwards, so as to compress the brain. This last danger, however, some modern surgeons consider as void of foundation; and whenever the symptoms indicate an affection of the brain, the nature of the case is referred to the intimate connection between the bones of the nose and the os frontis. (*Delpech, Précis des Mal. Chir.* t. i. p. 221. 8vo. Paris, 1816.)

Sometimes the fissure extends through the nasal process of the upper maxillary bone, and across the fossa for the lachrymal sac, attended with discharge of blood from the puncta lachrymalia and nostril, and obstruction to the passage of the tears. Mr Hooper, of the London Road, had a case, in which not only the fissure extended in this way, but the brain received injury from the blow, and the patient died. The accident was produced by a horse-brush being thrown with violence, and striking the face.

When there are symptoms of pressure on the brain (see Head, Injuries of,) and the ossa nasi are much depressed, the surgeon must immediately raise them, and endeavour to draw gently forwards the perpendicular process of the os ethmoides, which is connected with the cribriform lamella and crista galli. Perhaps, a pair of closed common forceps, introduced into each nostril, might best enable the surgeon to do what is necessary. Bleeding and the antiphlogistic treatment are always proper; for, the vicinity of the eye renders it liable to become inflamed; and when there are symptoms of injury of the brain, extravasation, &c. the necessity of such practice is still more strongly indicated.

Fractures of the Lower Jaw.

This bone is sometimes fractured near the chin; but, seldom so as to produce a division of the symphysis, the solution of continuity generally happening between this part and the insertion of the masseter. In University College Museum, however, there is a specimen of a fracture situated precisely at the symphysis. In other instances, the fracture occurs near the angles of the jaw, that is to say, between the insertion of the masseter and the root of the coronoid process. The bone may also be broken on each side at the same time; in which event, the middle portion is extremely difficult to keep right, because many of the muscles, which draw the lower jaw downwards, are attached to that part. The condyles and coronoid process are also sometimes broken.

Fractures of the lower jaw may be either perpendicular to its basis, oblique, or longitudinal: of the latter, examples have been known, in which a portion of the alveolar process with the teeth in it, was detached from the rest of the bone.

The soft parts are generally contused and wounded. An instance is reported by Dr. Richelot of the accident being complicated with an injury of the external maxillary artery. (*Archives Gén.* Jan. 1833.) J. L. Petit mentions one case, in which the bone was broken, and the coronoid process quite denuded, by the kick of a horse.

When the fracture is near the symphysis, the side on which the processus innominatus is situated is drawn downward and backward by the submaxillary muscles, while the other fragment is supported by the muscles which close the jaw. When the fracture is more backward, the displacement occurs in the same way, but not so easily. When the bone is fractured in two places, the middle portion is always pulled downwards and backwards by the muscles attached to the chin, while the two lateral pieces are kept up by the levator muscles. When the ramus of the jaw is broken, the masseter, being attached to both pieces, prevents any considerable degree of displacement. When the neck of the condyle is fractured, the pterygoideus externus will pull the condyle forwards.

When a blow has been received on the lower jaw, or the bone injured by a fall, or the pressure of some heavy body; when an acute pain is experienced in the part, and an inequality can be felt at the basis of the bone; when some of the teeth, corresponding to that inequality, are lower than the others; and when a crepitus is perceptible on moving the jaw; there can be no doubt of a fracture. When the gums are lacerated, or the bone denuded by a wound, the case is (if possible) still more manifest.

Fractures of the rami and condyles produce great pain near the ear, particularly when the jaw is moved; and a crepitus may be felt.

Fractures of the lower jaw, whether simple or double, are easily set, by pushing the displaced part upward, and a little forward, and then pressing on the basis of the bone, so as to bring it exactly on a level with the portion which has preserved its natural position. Indeed, the correctness of the reduction may always be rightly judged of, by attending to the line which the base of the jaw ought to form, and observing that the arch of the teeth is regular. The maintenance of the reduction, however, is difficult; and can only be well executed by supporting the lower jaw, and keeping it applied to the upper one. As the latter indication cannot be properly fulfilled in persons, whose teeth are very irregular, it is sometimes necessary to interpose an even piece of cork between the teeth on each side of the mouth, and against this cork the lower jaw is to be kept up with the bandage presently noticed, while the aperture, left between the incisores in the situation where no cork is placed, allows food and medicines to be introduced with a small spoon.

When the bone is fractured in two places, one on each side of the symphysis, and great difficulty is experienced in keeping the central fragment from being drawn downwards and backwards towards the os hyoides by the depression of the lower jaw, the instruments, proposed by Graefe, Lonsdale, and others, will fix the bone and prevent the displacement. The apparatus consists of a groove, for the reception of the arch of the teeth, and of a square plate of steel, which is placed under the chin, and admits of being screwed up to the part. On this plate a piece of cork, or a compress is put.

As soon as the fracture is set, the surgeon should adapt some thick pasteboard, previously wetted and softened with vinegar, to the outside of the jaw, both along its side and under its basis. Over this moistened pasteboard, a bandage with four tails is to be applied, the centre being placed on the patient's chin, while the two posterior tails are to be pinned to the front part of a nightcap, and the two anterior ones fastened to the same cap near the occiput. When the pasteboard becomes dry, it forms the most convenient apparatus imaginable for surrounding and supporting the fracture. A piece of soap-plaster may now be applied to the skin underneath, which will prevent any ill effects of the hardness and pressure of the pasteboard.

Until the bone is firmly united, the patient should be allowed only such food as does not require mastication, and it may be given by means of a small spoon, introduced between the teeth. Broths, soups, jellies, tea, and other slops, appear most eligible.

In order to keep the middle portion of the bone from being drawn downwards and backwards towards the larynx, it is frequently necessary to apply tolerably thick compresses just under and behind the chin; which are to be well supported by the bandage already described.

I need hardly state the necessity of enjoining the patient to avoid talking, or moving the jaw more than can be avoided.

When the condyle is fractured, as it is incessantly drawn forward by the action of the pterygoideus externus, and, on account of its deep situation, cannot be pressed back, the neck must, if possible, be pushed towards it. For this purpose, the bandage must be made to operate particularly on the angle of the jaw, where a thick compress should be placed,

Compound fractures of the lower jaw are to be treated on the same principles as similar injuries of other bones. If possible, the external wound should be healed by the first intention; and, when this attempt fails, care must be taken to keep the wound clean by changing the dressings about once in three days; but not oftener, lest the fracture suffer too much disturbance. Compound fractures of the jaw, and even simple ones, which are followed by abscesses, are liable to be succeeded by necrosis and exfoliations.

It now and then happens, that fractures of the lower jaw continue ununited: Dr. Physick's successful treatment of one such case with a seton, and Dupuytren's by sawing off the end of one fragment, I have already noticed.

Fractures of the coronoid process are stated not to admit of bony union.

Fractures of the Vertebræ.

On account of the shortness and thickness of these bones, they cannot be broken, without considerable violence. The spinous processes, which project backwards, are most exposed to such injury; for they are the weaker parts of the vertebræ, and most superficially situated. On this account, it is possible for them to be broken, without any mischief being done to the spinal chord. The violence, which is great enough to break the bodies of the vertebræ, must produce more or less concussion, or other mischief of the spinal chord; from which more perilous consequences are to be apprehended, than from the injury of the bones, abstractedly considered. The displaced pieces of bone may press on the spinal chord, or even wound it, so as to occasion a paralytic affection of all the parts, which derive their nerves from the continuation of it below the fracture.

There may be fractures of the vertebræ, without displacement; or fractures complicated with dislocation, or extravasation of blood on the membranes of the spinal chord, of which last occurrence several specimens are preserved in University College Museum. Sir Benjamin Brodie has noticed, that, in consequence of external violence, a narrow clot of blood may be extravasated, within the substance of the spinal chord, and that from its peculiar situation, it may be productive of the most dangerous symptoms. With respect to laceration of the chord and its membranes, he observes, that it may be torn completely through, or lacerated in one part and not in another; and, he refers to a case, described by M. Ollivier, in which the attachments of the nerves on one side were destroyed, and, not on the other.

As for the concussion, the minute organisation of the spinal chord may be injured by it, even when there is neither fracture, nor dislocation, and the investing membranes exhibit no effects of the injury. "In such cases, if there be an opportunity of examining the spinal chord at a very early period after the accident, the central part of it is found to be softer, than natural, its fibrous appearance being lost in that of a semifluid substance. If the patient survives for a longer period, the alteration of structure is perceptible in the whole diameter of the chord, and occupies from one to two inches, or even more of its length; and at a still later period, it has often proceeded so far as to terminate in its complete dissolution." (*Sir B. Brodie in Med. Chir. Trans.* vol. xx. p. 121, 122.)

Sir Astley Cooper divides fractures of the bodies of the vertebræ with displacement into two classes: first, those which occur above the third cervical vertebra; and, secondly, others which happen below that bone. The first cases, he says, are almost always *immediately* fatal, if the displacement be to the usual extent. In the second description of cases, death takes place at various periods after the injury. The reason of this difference is ascribed to the circumstance of the phrenic nerve originating from the third and fourth cervical pairs, whence, in the first class of cases, death is immediately produced by paralysis of the diaphragm, and the stoppage of respiration. (*On Dislocations*, p. 552.)

Sir Benjamin Brodie correctly refers the symptoms, which arise, as an immediate consequence of injuries of the spine; 1st, To concussion of the spinal chord; 2dly, To laceration, or division of its substance; 3dly, To pressure, made on it, either by displacement of bone, or by extravasated blood. Afterwards inflammation of the membranes of the chord may take place, and other organs may be secondarily affected, giving rise to another order of symptoms, which did not exist in the beginning. He adds, that, when the symptoms are viewed generally, they vary: 1st, according to the part of the spinal chord, on which the injury has been inflicted; 2dly, according to the kind and degree of injury, which the chord has sustained; 3dly, according as, from accidental circumstances, the life of the patient is prolonged for a longer, or shorter period, or ultimately preserved. (See *Brodie in Med. Chir. Trans.* vol. xx. p. 127.) These facts deserve to be particularly remembered, for, without the recollection of them, the practitioner would be extremely perplexed in his endeavours to explain the great differences in the symptoms, and results of different cases.

As the mere concussion of the spine may occasion symptoms, which resemble those, usually occurring, when the vertebræ are fractured, the diagnosis is generally obscure. An inequality in the line of the spinous processes, and a crepitus, may sometimes be distinctly felt. The lower extremities, and the rectum, and bladder, are generally paralytic; the patient being afflicted with retention of urine and involuntary discharge of the feces.

According to Sir Benjamin Brodie's observations, the patient is generally unconscious of the bladder being distended; but occasionally he suffers as from an ordinary retention of urine, though in a less degree. "The incapability of voiding the urine is usually an early symptom, and, in fatal cases, it continues to the last. When a complete, or partial recovery takes place, the power of emptying the bladder is restored sooner, than that of using the muscles of the lower limbs. In cases in which the catheter is not employed, the urine flows involuntarily, as in most other cases of overdistended bladder where the urethra is free." "At other times, there is a constant dribbling of urine, although the bladder is in a contracted state, so that, on the introduction of the catheter, no urine flows." (*Sir B. Brodie, in Med. Chir. Trans.* vol. xx. p. 141.)

With respect to *paralysis of the voluntary muscles*, Sir Benjamin Brodie remarks, that, if the spinal chord be divided through its whole substance, or extensively lacerated, or subjected to any considerable pressure, the paralysis is immediate and complete. But, if the injury be partial, certain muscles may be paralysed, while others retain their power of voluntary motion. He notices also the well-known fact, that paralysis of the lower limbs is more common, than that of the upper. "In some cases, in which the injury has affected the spinal chord in the lower part of the neck, the lower limbs are rendered paralytic, while there is either no paralysis, or a less degree of it, in the upper limbs. The reason of this is sufficiently obvious to any one who considers what are the origins of the nerves, which form the axillary plexus, some of them being probably above the part which is injured. But the circumstance is still remarkable in this respect, that it is contrary to what happens, when the functions of the spinal chord are interrupted in consequence of caries of the cervical vertebræ. In these last cases, the paralysis is often complete in the upper limbs for many weeks, or even for months, before it extends to the lower. I have met with only a single case, in which, after an injury of the cervical portion of the spine, there was almost complete paralysis of the muscles of the upper extremities, and none whatever of those of the lower." (*Sir B. Brodie in Med. Chir. Trans.* vol. xx. p. 129.) I think, we must agree with the same experienced surgeon that, when paralysis of the upper and lower limbs follows a fracture of the lumbar vertebræ, an instance of which is recorded by Mr. Stafford, or when it follows a concussion of the loins, as once seen by Sir Benjamin Brodie himself, we must suppose, that another part of the spinal chord, as high as the origin of the nerves, which form the axillary plexus, has suffered from the effects of concussion.

On the subject of *affections of the nerves of sensation*, Sir Benjamin Brodie after noticing the well-ascertained fact, that if the spinal chord be lacerated, or subjected to any considerable degree of pressure, the sensibility of the parts below the seat of injury is totally destroyed, refers to another, which is, that, if the injury be in the situation of the sixth or seventh cervical vertebra, the destruction of sensibility is frequently partial in the upper extremities, while it is complete in the trunk and lower extremities. "In many instances, the destruction of sensibility is incomplete at first, but becomes complete afterwards, as the process of softening makes progress in the injured portion of the spinal chord." (*Sir B. Brodie in Med. Chir. Trans.* vol. xx. p. 135.)

With respect to the *affection of respiration*, if the fracture be as high as the third cervical vertebra, and the chord be there injured, the nervous influence cannot be transmitted either to the diaphragm, or the other muscles of respiration; and a fatal asphyxia immediately takes place. But, if respiration be performed artificially, by inflating the lungs, the action of the heart and life may be maintained for several hours. When the spinal chord is seriously injured in the lower part of the neck, below the origin of the phrenic nerves, or in the upper part of the back, the action of the diaphragm is not interfered with, while the intercostal muscles, as well as the muscles of expiration, are paralytic. "The patient, therefore, breathes by the diaphragm only. The ribs are motionless, and the air is expelled from the lungs, not by the contraction of the abdominal muscles, but simply by the elasticity of the abdominal parietes, and the pressure of the abdominal viscera, operating on the lower surface of the diaphragm, where that muscle is relaxed." Under these circumstances, the patient is incapable of expectorating mucus, if it be collected in the trachea; if he coughs, it is by a forcible inspiration, followed by a sudden relaxation of the diaphragm; and respiration is carried on with more difficulty in the sitting, than the recumbent posture. But, it is further observed by Sir Benjamin Brodie, that injuries of the spinal chord in the lower part of the neck, are not necessarily followed by the foregoing consequences. The pressure on the spinal chord may be so small, or the disorganisation of it from concussion may be so trifling, that the muscles of respiration are not at any period affected by it; or they may not be so in the first instance, and yet become affected afterwards. In one case, which fell under Sir Benjamin Brodie's observation, a fracture of the seventh cervical vertebra, which was followed by a softening and dissolution of the spinal chord, the difficulty of respiration did not take place until the twelfth day; but death occurred in less than three days afterwards. (See *Med. Chir. Trans.* vol. xx. p. 138.)

Injuries of the spinal marrow, including those resulting from, or accompanying fracture, are well known to produce certain *changes in the urine and urinary organs.* Besides an inability of voiding the urine, there is sometimes, as Sir Benjamin Brodie has pointed out, a marked diminution in the quantity of this fluid secreted. In some cases, the urine, first secreted, although of an acid quality and free from mucus, has a peculiarly offensive smell; while, in others, it is exceedingly acid, with an opaque yellow appearance, and a yellow amorphous sediment. But, the most common changes are an ammoniacal smell, great turbidness, and a deposit of a large quantity of adhesive mucus, and the urine, when tested with reddened litmus, or turmeric paper, is found to be very alkaline. After some time, phosphate of lime, secreted by the inner coat of the bladder, is blended with the mucus, which is tinged with blood. These appearances may come on as early as the third or fourth day, or not begin for a week, or eight, or nine days. Sir Benjamin Brodie has not found, that injury of one part of the spine is more liable to produce them, than that of another. In fatal cases, they sometimes continue to the last. At other times, they go on for two or three weeks, and then subside. Occasionally the urine varies from day to day, being now alkaline and depositing adhesive matter; then clear and acid; and afterwards alkaline again. (*Sir B. Brodie.*)

Fractures and other injuries of the spine frequently bring on inflammation of the mucous membrane of the bladder and ureters; and occasionally spots of extravasated blood are found in the kidneys. In University College Museum is a bladder, taken from a patient, who died of an injury of the spine, which is in a softened and ulcerated state. In Mr. Barlow's case, the infundibula and pelvis of the kidneys were dilated with urine, which was mixed with pus. The bladder, whose coats were thickened, also contained a considerable quantity of pus. (See *Med. Chir. Trans.* vol. xvii. p. 120.)

Wherever the injury of the spinal chord is situated, the bowels are torpid, and the abdomen tympanitic. In many cases, where the cervical portion of the chord is injured, and the patient dies in two, or three days, there is a disposition to vomit. In more protracted cases, the discharges from the bowels are of a black colour, semifluid, and of a peculiarly offensive smell. It would appear also, both from the experiments of M. Chossat, and facts, recorded by Sir Benjamin Brodie, that injuries of the superior portion of the spinal chord are sometimes followed by a remarkable evolution of animal heat. (See *Med. Chir. Trans.* vol. xx. p. 146.)

With respect to effects on the sensorium immediately after the accident, Sir B. Brodie has not observed any material ones, except where the injury was of the cervical portion of the spinal chord, and then, he observes, that the results are very different in different cases. (*Ib.* 149.)

If the lumbar vertebræ are displaced, the lower extremities are rendered so completely insensible, that they may be pinched, burnt, or blistered, without the patient suffering any pain. The penis, in such cases, is generally erect. In general, also, according to Sir Astley Cooper's observations, patients, with fractured lumbar vertebræ, die within a month, or six weeks; but, he knew of one patient that lived two years, and then died of gangrene of the nates. In fractures with displacement of the dorsal vertebræ, the symptoms are very similar; but, the paralysis extends higher, and the abdomen becomes excessively inflated. Death commonly follows in two or three weeks; but, Sir Astley Cooper remembers one case, in which a gentleman survived the accident nine months. According to Sir B. Brodie's experience, where a considerable injury has been inflicted on the spinal chord in the lower part of the neck, or in the neighbouring part of the back, of such a nature, as to paralyze all the muscles of respiration, excepting the diaphragm, the patient rarely lives to the end of the fourth, or fifth day; and mostly dies still earlier. (See *Med. Chir. Trans.* vol. xx. p. 156.) Fractures of the cervical vertebræ, below the origin of the phrenic nerve, occasion paralysis of the arms, though it is seldom complete. Sometimes, when the fracture is oblique, one arm is more affected than the other. As the intercostal muscles are paralytic, great difficulty of respiration prevails. The abdomen is also considerably inflated. Death generally follows in from three to seven days.

Sir Benjamin Brodie has never known priapism occur from injury of the spinal chord, except in combination with paralysis. It "may take place (he observes) whether the patient suffers from the effects of simple concussion of the spinal chord, or from those of pressure. It seems to be connected with injuries of the upper, rather than with those of the lower portion of the chord: at least, I am not aware, that I have met with it, where the seat of injury has been below the sixth dorsal vertebra. It is for the most part an early symptom, showing itself in the course of the second, or third day, and it seldom continues after the first fortnight. It occurs even where the sensibility of the parts is totally destroyed, and may be induced by the mechanical irritation caused by the introduction of the catheter, where the patient is entirely unconscious of the operation. This circumstance was pointed out to me, many years ago, by Professor Macartney, of Trinity College, Dublin; and I have had many opportunities of verifying the correctness of the observation." (*Sir B. Brodie*, in *Med. Chir. Trans.* vol. xx. p. 140.) In the North London Hospital, one case occurred under Mr. Liston, in which priapism accompanied a fracture of the lumbar vertebræ, and Sir Benjamin Brodie informs me, that he has lately heard of another similar case. We had also in the North London Hospital, an instance, where priapism was one of the symptoms, following a violent blow on the occiput.

Sir Astley Cooper notices the following, as the appearances found in *post mortem* examinations. The spinous process of the displaced vertebra is depressed; the articular processes are fractured; the body of the vertebra is broken through, the separation rarely happening in the intervertebral substance. The body of the vertebra usually projects forward half an inch, or an inch. Between the vertebra and the sheath of the spinal marrow, blood is extravasated, and frequently on the spinal chord itself. When the displacement is slight, the spinal marrow is compressed and bruised. When greater, it is torn through by the bony arch of the spinous process, and a bulb is formed at each end, but the dura mater continues whole. (See *Sir A. Cooper on Dislocations, &c.* p. 554, &c.)

Fractures of the spinous processes, without other serious mischief, are not dangerous. It has usually been thought, that, even when a fracture of the spine is attended with displacement, any attempt to bring the fragments into a better position would be too dangerous to be made. Some practitioners have, however, ventured upon it. Mr. Barlow, of Writtle, did so, and, though no harm resulted from the experiment, it cannot be said that any permanent good was derived from it, for, when the patient died some months afterwards, the fracture had united still in a displaced condition. It was "performed by persons pulling at the superior and inferior extremities, which had the desired effect; for, the angular projection was greatly lessened, and the patient did not seem to experience any pain during the extension." The following particulars show, however, that the displacement was far from being obviated. The case was a transverse fracture of the first lumbar vertebra, extending obliquely downwards and forwards, through the upper portion of its body. "The upper part of the vertebral column, together with the upper fragment of the fractured vertebra, had been thrown forwards, the superior fragment resting on the fore and upper part of the inferior fragment, to which it was connected by callus. The corresponding articular process of the last dorsal and first lumbar vertebræ had been dislocated; those of the former having been thrown upwards and forwards. On the right side, the inferior articular process of the last dorsal vertebra was separated from the corresponding process of the first lumbar to the extent of a third of an inch, while their surfaces were rounded and nearly obliterated. On the left side, the processes were about the same distance from each other, but connected by an intermediate portion of new bone. The formation between the roots of the spinous processes was more than twice its natural dimensions. The ligamentum subflavum must have been ruptured. The vertebral canal, immediately behind the line of fracture, was diminished one half in calibre." (*W. R. Barlow*, in *Med. Chir. Trans.* vol. xvii. p. 115.)

The following is the view, adopted by one high authority. "Dislocations and fractures, with displacement of the cervical vertebræ, are not always immediately fatal; and I cannot say, that no circumstances can exist, which would justify the attempt to effect reduction in such cases; but it is evident, that, if the attempt be made at all, it must be with the greatest caution, and Boyer describes a case, in which a child died under it. There can be no doubt, however, that, when the injury is in the lower part of the spine, the attempt to effect reduction may be not only made with impunity, but that it may be successful. In proof of this assertion, I may refer to a case, which occurred in the practice of Mr. Hardwicke, of Epsom; the patient being afterwards admitted into St. George's Hospital, labouring under paralysis of the lower limbs." Sir Benjamin Brodie likewise refers to another case under his care in the same hospital; a fracture, with great displacement of the third and fourth lumbar vertebræ. By fixing the thorax, and cautiously extending the pelvis, he endeavoured to restore the vertebræ to their proper place. "The attempt was in some degree successful, no ill effects of any kind resulted from it." (See *Med. Chir. Trans.* vol. xx. p. 158.)

In the instances seen by Mr. Crosse, in which a fracture of the spinal column was attended with displacement, producing pressure on the medulla, and paraplegia, the compressing portion of the bone was almost universally the body of a vertebræ, so generally broken, and not the arch. (See *Trans. of Prov. Med. Assoc.* vol. v.)

If, after a certain time, circumstances justify the suspicion of inflammation of the spinal chord, and the state of the pulse will admit of the practice, venesection should be employed; but, inasmuch as cupping the part near the injury could not be performed without turning the patient, and disturbing the fracture, I deem it always unadvisable. The same remark applies to leeches. I believe, with Sir Benjamin Brodie, however, that it is a great mistake to suppose that bleeding is always proper. "In the majority of cases, the state of the pulse is such as actually to contra-indicate the abstraction of blood; and the blood, when drawn, does not in general present those appearances, which are supposed to mark the existence of inflammation." (*Sir B. Brodie,* in *Med. Chir. Trans.* vol. xx. p. 162.) Neither does blood-letting seem to this gentleman to arrest the process of softening and dissolution of the spinal chord, but, on the contrary, to accelerate it.

Keeping the vertebral column perfectly motionless is an indication plainly presenting itself, and the best mode of fulfilling it is to let the patient lie steadily on his back.

When the patient is affected with a flatulent distention of the abdomen, vomiting, hiccough, &c, the belly may be rubbed with camphorated liniment; and purgative or turpentine clysters, and antispasmodics given.

In all cases, in which the lower part of the body is paralytic, the catheter is necessary. "It does not, however, prevent the urine becoming alkaline, nor the secretion of adhesive mucus from the lining membrane of the bladder. When these changes have taken place, the bladder should be emptied several times daily; and it may be advisable in some instances to inject tepid water into it, so as to prevent any portion of the mucus being retained in its cavity." (*Sir B. Brodie.*)

The torpid state of the bowels demands active purgatives, as calomel, jalap, castor and croton oil. Sir B. Brodie finds that the action of purgatives, in these cases, is promoted by combining them with ammonia. When the motions are black and offensive, attention to this part of the treatment is of high importance. (*Op. et* vol. *cit.* p. 163.)

When the bladder, rectum, and lower extremities are paralytic, Boyer advised rubbing the back, loins, sacrum, and limbs with liniments containing the tincture of cantharides. With respect to the external and internal use of stimulants, however, it can never be judicious, when there is reason to apprehend much inflammation of the injured parts; and as for the idea of thus restoring the nervous influence, there can be little chance of success, the cause of its interruption being here of a mechanical nature. (*Delpech, Mal. Chir.* t. i. p. 222.) In an early stage of the case, who would venture to move the patient about for any purpose of this kind?

Some authors recommend trepanning, or cutting out a portion of the fractured bone, when the compression of the spinal marrow, or its injury by a splinter, is suspected; but, according to my judgment, the indication can never be sufficiently clear to authorise the operation, which, on account of the great depth of the intervening soft parts, must be tedious, and even difficult to effect, without risk of increasing the injury, which the spinal marrow may already have received. An unsuccessful operation of this kind was once performed by Mr. H. Cline, and another by Mr. Tyrrell.

Some cases, published by Sir C. Bell, tend to prove, that the danger to be apprehended from injuries of the vertebræ, is the same as that which accompanies injuries of the brain. Hence, he is an advocate for general and local bleeding, and keeping the patient perfectly quiet. But, with respect to operations for the removal of fragments of bone, it is his decided belief, that an incision through the skin and muscles covering the spine, and the withdrawing of a portion of the circle of bone, which surrounds the marrow, would be inevitably fatal, the membranes of that part being particularly susceptible of inflammation and suppuration. And, even if a sharp spicula of fractured bone had run into the spinal marrow, and caused palsy of the lower parts of the body, Sir C. Bell thinks, that exposing the medulla to extract the fragment would so aggravate the mischief, that inflammation, suppuration, and death, would be the inevitable consequences. (*Surgical Obs.* vol. i. p. 157.)

The question, respecting such an operation, seems to Sir Benjamin Brodie to lie in a very small compass. "If the whole, or nearly the whole, of a vertebra be driven forwards, the depression of the posterior part of it will, of course, occasion a diminution of the size of the spinal canal; but the removal of any portion of the vertebra, which is accessible to an operation, will be of little avail, as the irregularity in the anterior part of the canal, made by the displacement of the body of the vertebra, must be the same after, as it was before, the operation." This view coincides with that which I have long entertained. (See *First Lines of Surgery*, ed. vi. p. 586.) "If (observes Sir Benjamin Brodie) there be simply a fracture on each side of the spinous process, with a depression of the loose or intermediate portion of bone, there must be a corresponding diminution of the size of the vertebral canal; but, as that canal is much larger than the spinal chord, which it contains, it does not follow, that the spinal chord is really compressed, or that any material diminution of the symptoms would follow the elevation or the depression. But, let it be supposed that the spinal chord is really suffering from pressure, a much less degree of violence, than that which is necessary to occasion a fracture of the spine, may produce concussion, softening, and ultimately dissolution of the spinal chord, with a train of symptoms much worse than those which arise from simple pressure. Now, no operation can be of the smallest advantage in this respect; but, on the contrary, if it be necessary to apply the saw in the performance of it, the jar and disturbance of the parts, which it must occasion, is even likely to aggravate the mischief. If these views be correct, it is evident that the cases, in which there are any reasonable grounds for the performance of the operation, must be of very rare occurrence." (*Sir B. Brodie,* in *Med. Chir. Trans.* vol. xx. p. 160.) In fact, no operation of this kind has yet been the means of preserving life, or even of relieving the worst symptoms.

Sir Charles Bell describes inflammation of the spinal marrow as "attended with an almost universal nervous irritation, which is presently followed by excitement of the brain; in the mean time, matter is poured into the sheath of the spinal marrow, and either by its pressure causing palsy, or by its irritation disturbing the functions of the part, so as to be attended with the same consequences. The excitement of the brain being followed by effusion, death ensues." (p. 159.) Cases are also referred to, where palsy of the lower extremities comes on several months after an injury of the spine, owing to thickening of the membrane of the medulla, or disease of the latter part itself. Here Sir C. Bell recommends perseverance in local bleeding, and deep issues. (p. 160.)

When recovery takes place, the restoration of sensibility usually precedes that of the power of voluntary motion. The power of emptying the bladder is also sooner restored, than that of using the muscles of the lower limbs. (*Sir B. Brodie, Op. et* vol. *cit.* p. 136.—141.)

A fracture of the processus dentatus almost always proves instantly fatal, as happened in the example mentioned by Sir A. Cooper. (*On Dislocations, &c.* p. 548.) In the article Dislocation, I have adverted to the remarkable instance of a fracture and displacement of the atlas, where the patient lived forty-seven weeks after the accident, and to the last week of his life was able to walk to the water-closet, which was on the same floor with his bed. After death, " the condyles of the occiput still rested upon the articulating surfaces of the atlas, but the atlas was found to be not a separate and independent vertebra, but an appendix to the axis. So much of its anterior portion, as includes the surfaces by which it is articulated with the occiput and with the axis, had been violently separated from the posterior portion of its ring, and had been carried in an oblique direction downwards and forwards, until it arrived upon the same plane, but anterior to the axis, to the body and transverse processes of which it became attached by perfect bony union, while the posterior fragment had suffered no displacement. Under these circumstances, the bone presented two spinal foramina, and four transverse, but no odontoid process. This organ having been fractured and separated, no organ passed through the anterior spinal foramen." (*B. Phillips*, in *Med. Chir. Trans.* vol. xx. p. 82.) In the practice of Mr. Cline a case occurred, in which a boy, with a fracture of the atlas, lived a year after the accident.

The particulars of the following case, under my care in University College Hospital, were registered by Mr. Morton, then house surgeon:—Thomas Robinson was admitted November 2. 1835, for injuries received by the fall of a very heavy piece of timber on the lower part of the neck, a short time before he was brought to the hospital. He was perfectly sensible; the pupils were quite active under the influence of light, and no symptom prevailed, indicating affection of the brain. His arms and superior extremities were completely paralysed. If raised up, and the support then removed, they immediately dropped. The man had lost all sensation in the inferior extremities and in the trunk, as high as the middle of the chest. Also in the arms, excepting from the point of the shoulder down to the elbow. He had *priapism*, with *emissio seminis*. Respiration was performed imperfectly, and in a short hurried manner. Though pain was experienced in the back of the neck, when the head was moved, no crepitus was distinguishable. The skin was rather cold: at first merely external warmth was applied, and some tea given. On the day after that of the patient's admission, the skin was warm, respiration quicker, and pulse more frequent, but perfectly compressible. He was placed on his side at his own request. In respiration, no action of the intercostal and abdominal muscles could be perceived. As no urine had passed, a pint was drawn off with a catheter; and gr. viij. of calomel, followed by aperient mixture, were given to promote evacuations from the bowels. The mixture was rejected by vomiting. In the afternoon, the pulse had risen to 120 beats in a minute, and the difficulty of breathing had increased. The face was flushed, and skin hot. Twenty-four ounces of blood were taken away; but without benefit, as the pulse afterwards rose to 156, and became irregular both as to rhythm and strength. Death took place twenty-four hours after the accident. In the *post mortem* examination, the right articular process was found detached from the body of the third vertebra. The left portion of the arch of the fourth was broken, *but not displaced*. The arch of the fifth was much comminuted, and the spinal chord exposed, and pressed upon. The body of this vertebra was also broken through, and the sharp edge of the fracture had caused copious extravasation behind the pharynx, in front of the vertebral column.

William Parker, æt. 13, was admitted under me, October 15. 1836, in consequence of his cravat having been caught by some machinery, and his neck drawn against a projecting lever. In this position, he had been suspended about a minute and a half, and directly he had been released, he was brought to the hospital. His breathing was then slow, and somewhat laboured, the face slightly livid, the pupils acted, the hands were warm, and the pulse rather slow and feeble. The boy was laid on a table, and covered with blankets, and the windows opened to admit of a supply of fresh air. The breathing, however, did not improve, and inspiration gradually became slower, and the intervals of respiration longer. In eight or ten minutes the lips became livid, the pulse sunk, and the surface of the limbs and trunk began to grow cold. Hot water was applied to the feet, the chest, and epigastrium, and artificial respiration was resorted to by closing the nostrils, and blowing air into the mouth through a piece of muslin. This soon brought a rosy colour into the cheeks, the pulse became stronger, the temperature of the body rose, and some slight effort at respiration was supposed to be made. A little ammonia and water was put into the mouth, but could not be swallowed. At the same time, the vapour of strong liq. ammon. was applied to the nostrils. Whenever the artificial respiration was discontinued, the breathing went on but slowly and feebly, the pulse sunk, and the lips became livid. In this manner he went on for some hours, the vital powers partially recovering, while artificial respiration was carried on, and sinking directly it was interrupted. Although there was great suspicion entertained that the spine had suffered injury, I wished to render the introduction of air into the lungs as complete as possible, and therefore performed tracheotomy, so that a small pair of bellows might be used for this purpose. But neither this plan, nor galvanism, tried by Dr. Ritchie, was of any material service; and death took place at the end of six hours and a half. In the *post mortem* examination, blood was found effused between the muscles in front of the cervical vertebræ. The anterior common ligament was ruptured opposite the second and third vertebræ. A considerable quantity of blood was found in the intermuscular cellular tissue behind the cervical vertebræ, opposite the second, third, and fourth of them. A fracture of the arch of the third was detected, the part of it above the spinous process being broken off, and the portion of it on each side of that process also fractured. Although the fragment might have been depressed, it did not seem to be so at the period of examination. In the spinal canal, blood was effused; but there was no apparent laceration of the dura mater, or injury of the chord: the bowels were greatly distended with air. This case, which I have also referred to in the article ASPHYXIA, illustrates the consequences of an injury of the spinal chord, implicating the origins of the phrenic nerves.

A. Cooper, Op. cit. p. 549. See *L. T. Soemmering*, Bemerkungen über Verrenkung und Bruch des Ruckgraths, 8vo. Berlin, 1793. *F. A. E. Cuenotte*, Dis. Med. Chir. sistens Casum Subluxationis Vertebræ Dorsi cum Fractura complicatæ, postfactam Repositionem et varia dira Symptomata duodecima demum Septimana funestæ. Argent. 1761. Case of Fractured Spine, Lancet, vol. ii. p. 97. *C. Wenzel*, Von den Krankheiten am Rückgrathe. Bamberg, 1824, fol. *Sir Charles Bell*, On Injuries of the Spine and Thigh-bone. Lond. 4to. 1824. *B. Phillips*, in Med. Chir. Trans. vol. xx. *Sir B. C. Brodie*, ibid.

FRACTURES OF THE STERNUM.

The sternum is less frequently broken than its exposed position might lead us to expect; and the reason of this fact is imputed to the bone resting, as it were, upon the yielding cartilages of the ribs, and also, in some measure, to its spongy texture. When the accident does occur, it is from the direct application of external violence to the injured part; and hence the fracture is always accompanied with contusion, or even a wound of the integuments, and more or less injury of the thoracic viscera. As Boyer remarks, the sternum, in consequence of the elasticity of the cartilages of the ribs, may be readily propelled backward by pressure in this direction, and the result is an actual change in the form, and a real diminution of the chest. Now, since this cavity is always accurately filled by its contents, these alterations cannot happen in a considerable and sudden manner, without a risk of the thoracic viscera being contused and even ruptured. Thus, when the sternum has been fractured by violent blows on the chest, the heart and lungs have been found severely contused, and sometimes lacerated; and there will always be greater danger of such mischief, when the fracture is attended with depression of one or more of the fragments. In the museum of University College is a heart, the right ventricle of which was lacerated by the fragment of a broken sternum. M. Sanson saw a similar occurrence. (See *Dict. de Méd. et de Chir. Pratiques*, art. *Fracture.*) In some cases, a large quantity of blood is effused in the cellular tissue of the anterior mediastinum; and, in others, the accident is followed by inflammation, and suppuration in the same situation, and necrosis of the broken part of the bone. Since the lungs are also liable to be ruptured by the same force, which causes the fracture, or wounded by the depressed pieces of bone, emphysema may be another complication, as was exemplified in a case related by Flajani. (*Collezione d'Osservaz. &c. di Chir.* t. ii. p. 214. 8vo. Roma, 1802.)

If dependence can be placed upon the particulars of a case, recorded M. David, the sternum may be broken by the violent action of the muscles connected with it (*Mém. sur les Contrecoups*), and sometimes, from the same cause, in the efforts of parturition.

A fracture of the sternum is rendered obvious by the inequalities perceptible, when the surface of the bone is examined with the fingers; by a depression, or elevation of the broken pieces; a crepitus and an unusual moveableness of the injured part in respiration. The breathing is difficult, and mostly accompanied with cough, spitting of blood, palpitations, and inability to lie on the back. According to the observations of Petit and Baldinger, several of these latter symptoms may continue, with less intensity, a long while after the fracture has been cured. (*Leveillé, Nouvelle Doctrine Chir.* t. ii. p. 243.) When displacement occurs, the lower fragment generally is pushed forwards, or even more or less overlaps the upper.

Fractures of the sternum, when mere solutions of continuity, only require common treatment; viz. a bandage round the chest, quietude, bleeding, and a low regimen, with the view of preventing what may be considered as the most dangerous consequence, inflammation within the chest.

In cases, attended with great depression of the fractured bone, the necessary incisions should be made, in order to raise with an elevator the portions of the bone driven inwards, or to extract with forceps any loose splinters, which seem to be similarly circumstanced. However, it is not often necessary to trephine the sternum, either to raise a depressed portion of the bone, or to discharge extravasated fluid. In the first circumstance, I believe with Sir C. Bell, that the formal application of the trephine can never be right, though the surgeon may be called upon to extract loose splinters. (See *Operative Surgery*, vol. ii. p. 218.) Such an operation, however, may occasionally be proper when abscesses form under the sternum, or the bone is affected with necrosis, and the natural separation of the diseased parts is likely to occupy a considerable time.

Fractures of the sternum are more frequently produced by gunshot violence, than any other cause, and in these cases the splinters may require extraction. At the battle of Marengo, the French general Champeux received such a wound, with which he lived nearly a month: the injury was attended with so many splinters, that when they were removed, the pulsations of the heart were visible to a considerable extent. (*Leveillé*, vol. *cit.* p. 214.)

The ensiform cartilage, when ossified in old subjects, is liable to fracture. Little more can be done in such a case, than to relax the abdominal muscles by raising the thorax and pelvis, and then apply a bandage to the part, for the purpose of keeping it steady. When the blow has been violent, the patient should be freely bled.

FRACTURES OF THE RIBS

Generally happen near the greatest convexity of these bones, several of which are often broken together. The first rib being protected by the clavicle, and the lower ribs being very moveable, are less liable to fracture, than the others. When the spicula of a fractured rib is beaten inward, it may lacerate the pleura, wound the lungs, and cause the dangerous train of symptoms attendant on emphysema. (See EMPHYSEMA.) The pointed extremity of the rib, projecting inwards, may cause an extravasation of blood; or, by its irritation, produce inflammation in the chest. A fracture, not at all displaced, or situated under thick masses of muscle, may be difficult to detect, particularly in fat subjects; and, no doubt, is frequently never discovered. The surgeon should place his hand on the part, where the patient seems to experience a pricking pain in the motions of respiration, or where the violence has been applied. The patient should then be requested to cough, in which action the ribs must necessarily undergo a sudden motion, by which a crepitus will often be rendered perceptible. All the best practitioners, however, are in the habit of adopting the same treatment, when there is reason to suspect a rib to be fractured, as if this were actually known to be the case by the occurrence of a crepitus, or the projection of one end of the fracture; which, indeed, in the instances which are displaced, makes the nature of the accident sufficiently plain.

A broken rib cannot be displaced either in the direction of the diameter of the bone, or in that of its length. The ribs, being fixed posteriorly to the spine, and anteriorly to the sternum, cannot become shortened. Nor can one of the broken pieces become higher, or lower, than the other, because the same muscles are attached to both fragments, and keep them at an equal distance from the neighbouring ribs. The only possible displacement is either outward or inward. In the treatment of simple fractures of the ribs, free from urgent symptoms, the principal indication is to keep the broken bones as motionless as possible. For this purpose, after a piece of soap plaster has been applied to the side, and over it proper compresses (supposing the displacement to be outwards), a broad linen roller is to be firmly put round the chest, so as to impede the motion of the ribs, and compel the patient to perform respiration chiefly by the descent and elevation of the diaphragm. A scapulary will prevent the bandage from slipping downwards. When the fractured part is depressed inwards, the compresses should be placed on the anterior and posterior part of the bone. As a roller is apt to become slack, many surgeons, with good reason, prefer a piece of strong linen, large enough to surround the chest, and laced with packthread, so as to compress the ribs in the due degree.

When there is reason, from the symptoms, to think the lungs injured, or disposed to inflame, copious and repeated bleedings should be practised. Indeed, as pleuritis, or pneumonia, is always liable to succeed the accident, and is a most dangerous occurrence, every person free from debility, either having a broken rib, or supposed to have such, should always be bled in the first instance. The mixtura cetacei, with opium, is an excellent medicine for appeasing the cough, which disturbs the fracture, and gives the patient infinite pain.

Fractures of the Sacrum.

The sacrum, although superficial, is less frequently broken than the other bones of the pelvis; a fact attributable to its thickness, its spongy texture, and the advantageous way in which it supports the weight and efforts of the whole trunk. For the sacrum to be broken, the violence must be exceedingly great, like that resulting from the fall of a very heavy body, or the passage of a carriage wheel over the convex side of the bone, or a fall from a great height on that part. On the other hand, fractures of the sacrum, when they do happen, are generally accidents of a most dangerous kind, because, in addition to other injuries, with which they, in common with all fractures of the pelvis, are liable to be complicated, great damage is done to the sacral nerves. Hence, retention of urine, inability to retain this fluid, involuntary discharge of the feces, paralysis of the lower extremities, &c. Another principal danger also depends upon the injury, which the pelvic viscera may have suffered from the same violence, which broke the bone.

When the fracture is situated at the upper part of the sacrum, which seldom happens on account of the thickness of the bone in that situation, there is no displacement, unless the bone is smashed, and the fragments are driven inwards by the same force which produced the fracture; a case, which always implies severe injury of the external and internal soft parts. But when the fracture occupies the lower portion of the bone, where it is less thick, the inferior fragment may be displaced inwards, towards the rectum. In general, fractures of the higher part of the bone are not easily detected. (See *Boyer, Mal. Chir.* t. iii. p. 152.)

When the violence has been such as to make it probable that it has extended its effects to the pelvic viscera, every means in the power of art must be adopted for the prevention of inflammation. In particular, copious bleeding should be practised, and, if necessary, repeated. Leeches should be applied to the vicinity of the sacrum, and the parts kept cool with the lotio plumbi acetatis. Any difficulty, either in the expulsion or retention of the urine and feces, will likewise claim immediate and constant attention. (See Urine, *Retention of, Incontinence of,* &c.) With regard to the particular means for promoting the union of the fractured sacrum, quietude is the most important; and after the risk of inflammation is over, all that can be done is to apply a roller round the pelvis, or a T bandage to the part, with or without a piece of soap plaster.

Fractures of the Os Coccygis.

Though much slighter than the sacrum, it is less frequently broken, because less exposed to external force, and capable of a degree of motion, by which it eludes the effects of violence. But, in elderly persons, in whom the different pieces are connected by anchylosis, a fall on the buttock, or a kick, may fracture this bone. The accident is known by the moveableness of the fragments, and the acute pain produced when the thighs are moved, the fragments being then disturbed by the action of the external sphincter, glutæus maximus, and coccygeus.

The treatment of fractures of the coccyx consists in enjoining quietude. The patient should avoid walking about, as this would put the gluteus maximus muscle into action, and disturb the broken bone. The patient should refrain from lying upon his back, or placing himself in a sitting posture. All formal attempts at reduction are not only useless in respect to the fracture, but hurtful to the soft parts, which are not in a state to bear handling without ill effects.

Fractures of the Ossa Innominata

Are generally produced by the passage of the wheels of heavy carriages over the pelvis, falls from great heights, the kicks of horses, &c., and are always attended with considerable contusion of the soft parts, and sometimes with great injury of the pelvic viscera. The anterior superior spinous process of the ilium is sometimes broken off by the kick of a horse. I have seen several examples of fracture of the pelvis by gunshot, some of which were accompanied by injury of the bladder or rectum.

The two ossa innominata may be broken together; but commonly only one of them is thus injured. Most frequently, the fracture takes place in the upper expanded portion of the bone, known under the name of the ilium, though sometimes it happens either in the ischium, or the os pubis. The solution of continuity may be limited to one part of the bone, or extend to several parts of it; and there may be a greater or lesser number of fragments, and these attended, or not, with displacement. In many instances, in which the pelvis has been violently jambed between two bodies, or run over by a heavy carriage, the bones of the pelvis, besides being fractured, are dislocated, some interesting examples of which accident are recorded by Sir A. Cooper. (*Surgical Essays*, part i. p. 49, &c.)

When I was an articled student at St. Bartholomew's Hospital, several cases presented themselves, in which the ilium, ischium, and os pubis, were found fractured on opening bodies after death; and, when the great violence necessary to produce the accident is considered, we cannot wonder that the injured state of the pelvic viscera should frequently prove fatal. In University College Hospital, some other instances of fracture of the pelvis have fallen under my notice. Fractures of the ossa innominata are unavoidably attended with more or less contusion of the soft parts; and when the violence has been very great, the pelvic viscera may be seriously bruised, crushed, or lacerated, and the large nerves contained in the pelvis, or the spinal marrow itself, injured: hence, extravasation of blood or urine in the cellular tissue of the pelvis; ecchymosis deeply situated; injury of the kidneys; complete loss of motion; paralysis of the lower extremities; discharge of blood, or a black bilious matter, by vomiting or stool, either immediately or at more or less distant periods from that of the accident; retention of urine; fever; painful tension of the abdomen from inflammation of the peritoneum and bowels; the formation of abscesses, which are sometimes of great extent; sloughing; and death. (*Boyer, Mal. Chir.* t. iii. p. 154.)

As the same author has observed, the violence, occasioning a fracture of the ossa innominata, may produce a displacement of the fragments, and carry them more or less away from their natural situation. When the os pubis, or ischium, is broken, the splinters may be propelled into the urethra, or even through the bladder, and give rise to extravasation of urine; or by merely compressing these organs, they may cause more or less interruption of their functions. But, unless the fragments be displaced by the same force which caused the fracture, they can hardly be drawn out of their place by any other circumstance, since they are retained by the muscles attached to both fragments, and by surrounding ligamentous expansions.

Owing to the deep situation of fractures of the pelvis, and to there being generally no displacement nor mobility of the fragments, the diagnosis is sometimes attended with difficulty. A suspicion of the accident may be entertained, when the pelvis has suffered considerable violence, the patient experiences great agony, and all motion of the trunk and lower extremities is difficult and painful. If the fracture should be in the ilium, especially its upper and front portion, or in the os pubis, the mobility of the fragments, or even a crepitus, may be distinguished in a thin subject, if, when he is lying horizontally, with his thighs and legs bent, and his head and chest elevated, the projecting part of the os innominatum be taken hold of, and an attempt be made to move the fragments in opposite directions.

When the fracture is of a part of the os innominatum, very deeply placed, and is limited to a single point of the os pubis, or ischium, so that no detached moveable fragment has been produced, the exact nature of the case can rarely be made out with certainty, before the patient's death, and the dissection of the parts.

Fractures of the ossa innominata are accompanied with serious danger. When the fragments are displaced, and do not admit of being rectified again, the disorder arising from this cause may have fatal consequences. And, as Boyer observes, even when such displacement does not exist, these fractures are not the less to be apprehended, on account of the injury which the spinal marrow and the nerves, vessels, muscles, and viscera within the pelvis are likely to have sustained. These complications, which are exceedingly frequent, may prove indeed directly fatal, or destroy the patient at a period more or less remote from the time of the accident. One terrible accident of this kind, which happened close to my house at Shepperton, proved fatal in half an hour.

When the pelvic viscera and urethra have escaped injury, a cure of the fracture may be effected by means of rest; a position in which all the chief muscles attached to the pelvis are relaxed; and a roller or T bandage. (*Boyer, Mal. Chir.* t. iii. p.156.) Or the patient may be placed on a double inclined bed; a broad leather bandage may be passed round the pelvis, and buckled firmly in front of it, and the feet secured to the foot-board. (*Earle.*) The grand indication is to obviate the consequences of inflammation of the parts within the pelvis, and even of the peritoneum and abdominal viscera, by copious and repeated blood-letting. Any complaints, respecting the evacuation of the urine and feces, must also receive immediate attention. When there is great contusion, and the bones are badly broken, the patient cannot move nor go to stool, without suffering the most excruciating pain. To afford some assistance in such circumstances, Boyer, in a particular case, passed a piece of strong girth web under the pelvis, and collecting the corners into one, fastened them to a pulley suspended from the top of the bed. This enabled the patient to raise himself with very little effort, so that a flat vessel could be placed under him. In these and other cases, particularly compound fractures and paralytic affections from diseased vertebræ, the use of a bed constructed on the principles suggested by the late Sir James Earle, is of great service. (See *Obs. on Fractures of the Lower Limbs; to which is added, an Account of a Contrivance to administer Cleanliness and Comfort to the bed-ridden.* 1807.) Mr. Earle has also exerted his mechanical ingenuity with great success in the invention of a bed, admirably well calculated for the treatment of fractures, and other cases, in which it is an object of high importance to enable the patient to empty the bowels, without changing his position.

Sometimes, notwithstanding the rigorous adoption of antiphlogistic measures, abscesses cannot be prevented from forming in the pelvis; particularly, when there are detached splinters driven inwards. These collections of matter should be opened, as soon as a distinct fluctuation can be felt. The splinters may wound the urethra or bladder, and cause an extravasation of urine. Desault extracted a splinter, which had had this effect, from the bottom of a wound, made for the discharge of the effused urine. In these cases, a catheter should be employed without delay, and kept introduced, in order to prevent the urine from collecting in the bladder, and afterwards insinuating itself into the cellular tissue of the pelvis, or even into the cavity of the abdomen. (*Chopart.*) In University College Museum is a specimen of a fracture of the pelvis, which runs through the rami of the ischium and os pubis. The injury caused retention of urine, and laceration of the urethra by one of the fragments, followed by fatal extravasation of urine. An interesting case of fracture of the ossa innominata, attended with rupture of the bladder, and followed by fatal peritonitis, has been recorded by Cloquet. (*Nouveau Journ. de Médecine,* Mars, 1820.) The ossa pubis were forced half an inch from each other. The horizontal branch of the os pubis, and the ascending ramus of the ischium, were broken; the sacrum dislocated from the ossa ilium, and driven forwards within the cavity of the pelvis. The right sacro-iliac symphysis was broken only at its fore part, and its bones still retained their connection. Vast quantities of blood were found extravasated in the lumbar region, and about the pudenda. As soon as the abdomen was opened, three pints of a yellowish fluid, having an urinary smell, immediately gushed out. In this case, catheters of various sizes were introduced, even a syringe adapted to them was used, but nothing could be thus drawn off, but a few drops of blood. The possibility of mistaking a fracture of the acetabulum for a dislocation of the thigh-bone, and the differences of these cases, as explained by Sir A. Cooper, have been mentioned in the article Dislocation.

In some well marked cases, however, of fracture of the os innominatum, extending into the acetabulum, Mr. Earle found that the symptoms more nearly resembled those of fracture of the neck of the femur. Thus, in one example of fracture of the acetabulum in two directions, with an extensive comminuted fracture of the ilium, with some displacement, and a fracture of the os pubis in three places, the patient "had lost all control over the left lower extremity, and could not raise it from the bed. There was no visible shortening of the limb; but the foot was everted. Any attempt to rotate the limb caused great pain, and was accompanied with a very sensible crepitus when the hand was applied over the hip-joint." The trochanter on the injured side was not nearly so prominent as on the sound one, and almost on a level with the anterior superior spinous process of the ilium. (See *Med. Chir. Trans.* vol. xx. p. 250.) The patient recovered from these severe injuries; and, after a time, died of disease in the chest. The reparation of the fractures was complete. In University College Museum is a preparation, also exemplifying a recovery from an equally severe fracture of the pelvis, implicating the ilium, ramus of the left ischium, and the sacrum. The fractures are all united. In the above, and another instance, the particulars of which are given by Mr. Earle, the loss of prominence of the trochanter, and the freedom of motion of the joint, particularly of abduction, were the most marked symptoms. (See also *Wm. M'Tyer on Fractures connected with the Hip-Joint; Glasgow Med. Journ.* No. xiii.)

Fractures of the Thigh.

The thigh-bone is liable to be broken at any point, from its condyles to its very head; but it is in the middle third of this extent that fractures mostly occur, which are sometimes transverse, but more frequently oblique. The latter direction of the injury makes a serious difference in the difficulty of curing the case, without future deformity, or lameness. Sometimes the fracture is comminuted, the bone being broken in more places than one; and sometimes the case is attended with a wound, communicating with the fracture, and making it what is termed *compound.* As Petit remarks, however, the thigh-bone is less seldom broken into several pieces, than other bones more superficially situated.

A fractured thigh is attended with the following symptoms: acute pain at the instant of the accident; a sudden inability to move the limb; a preternatural mobility of one portion of the bone; a distinct crepitus, if the two ends of the fracture rub against each other; deformity, in regard to the length, thickness, and direction of the limb. The latter change, viz. the deformity, ought to be accurately understood; for, having a continual tendency to recur, especially in oblique fractures, the chief difficulty in the treatment is to prevent it. (*Desault, par Bichat,* t. i. p. 181.)

Almost all fractures of the thigh are attended with deformity. When this is considered, in relation to length, it appears that, in oblique fractures, the broken limb is always shorter than the opposite one; a circumstance denoting, that the ends of the fracture ride over each other. We may also easily convince ourselves, by examination, that the deformity is owing to the lower end of the fracture having ascended above the upper one, which remains stationary. What power, except the muscles, can communicate to the lower portion of the fractured bone, a motion from below upwards? At one end, attached to the pelvis, and, at the other, to this part of the bone, the patella, the tibia, and fibula, they make the former insertion their fixed point, and, drawing upward the leg, the knee, and the lower portion of the thigh, they cause, directly or indirectly, the displacement in question. In producing this effect, the triceps, semi-tendinosus, semi-membranosus, rectus, gracilis, sartorius, &c. are the chief agents.

For the purpose of exemplifying the power of the muscles to displace the ends of the fracture, mention is made, in Desault's works, of a carpenter, who fell from a scaffold, and broke his thigh. The limb, the next day, was as long as the other; but the man had a complete palsy of his lower extremities, and could not discharge his urine. The moxa was applied, the muscles soon regained their power, and then the shortening of the limb began to make its appearance.

Besides the action of muscles, there is another cause of displacement. However firm the bed may be on which the patient is laid, the buttocks, more prominent than the rest of the body, soon form a depression in the bedding, and thence follows an inclination in the plane on which the trunk lies, which, gliding from above downward, pushes before it the upper end of the fracture, and makes it ride over the lower one. The muscles, irritated by the points of bone, increase their contraction, and draw upward the lower part of the bone; and from this double motion of the two ends of the fracture in opposite directions, their riding over each other results.

Transverse fractures are less liable to be displaced in the longitudinal direction of the bone, because, when once in contact, the ends of the fracture form a mutual resistance to each other; the lower end, drawn upward by the muscles, meets with resistance from the upper one, which being itself inclined downward by the weight of the trunk, pushes the former before it, and thus both retain their position in relation to each other.

The deformity of a fractured thigh, in the transverse direction, always accompanies that which is longitudinal; but, sometimes, it exists alone. This is the case, when, in a transverse fracture, one end of the bone is carried outward, the other inward; or, one remains in its place, while the other is separated. The upper end of the fracture is not now, as in the foregoing instance, motionless in regard to the muscular action; for the contraction of the pectineus, psoas, iliacus internus, and upper part of the triceps, draws it from its natural direction, and contributes to displace it.

The deformity of the limb, in regard to its direction, is either the consequence of the blow, which produced the fracture, or, what is more common, of the ill-directed exertions of persons who carry the patient. Thus, an injudicious posture will bend the bone so as to make an angle.

Whatever may be the kind of deformity, the lower end of the fracture may retain the natural position in which it is placed, or else undergo a rotatory motion on its axis outward, which is very common, or inward, which is more unusual. This rotation always aggravates the displaced state of the fracture, and should be attended to in the reduction. (*Desault*, t. i. p. 180. 185.)

Three very different methods of treating fractured thighs are followed. In one, which was recommended by Hippocrates, and is preferred by a vast number of surgeons, the limb is kept in the straight or extended position. In another, the limb is laid upon its side, with the knee bent; a mode which was extolled by Pott, and has had many partisans in this country. To these two positions for fractured thighs is to be added that in which the patient lies upon his back, with his thigh and leg in the bent position, supported on two oblique planes, or surfaces, the apex or angle of which is beneath the ham.

That Pott lost sight of certain advantages of the straight position; that he was blind to the imperfections of the bent posture; and that he exaggerated the power, which we have, of relaxing all the muscles of a limb by position; few reflecting surgeons of the present day will be inclined to deny. Were we to believe the literal sense of several passages in Pott's Remarks upon Fractures, we should suppose it practicable to relax at once, by a certain posture of the limb, every muscle connected with a fractured bone. In the first vol. of his works, page 389. edit. 1783, he observes, in speaking of what must best answer the purpose of incapacitating the muscles from displacing the fracture: "Is it not obvious, that putting the limb into such position as shall relax the whole set of muscles belonging to, or in connexion with, the broken bone, must best answer such purpose?" and, in the next page, "What is the reason why no man, however superficially acquainted with his art, ever finds much trouble in setting a fractured os humeri? is it not because both patient and surgeon concur in putting the arm into a state of flexion, that is, into such a state as relaxes all the muscles surrounding the broken bone?" Also, in page 393. he continues, "Change of posture must be the remedy, or rather, the placing the limb in such manner as to relax all its muscles." Putting out of present consideration the disputed point, whether the relaxed state of a muscle is really the most efficient for the prevention of those spasms, which displace a fracture, and occasion vast suffering (see *J. Houston*, in *Dublin Journ. of Med. Science*, vol. viii. p. 459.), the possibility of perfectly relaxing all the muscles of the limb by any position, so long as different muscles have different uses, different situations, and different attachments to the bones, every one must grant to be only a visionary project. For instance, do not the patient and surgeon, in the case of fractured os humeri, adverted to above, concur in putting the fibres of the triceps and anconeus into a state of tension, at the same moment that they relax the biceps and brachialis internus?

The position of the fractured os femoris, says Pott, should be on its outside, resting on the great trochanter; the patient's whole body should be inclined to the same side; the knee should be in a middle state between perfect flexion, or extension, or half-bent; the leg and foot, lying on their outside also, should be well supported by smooth pillows, and should be rather higher in their level, than the thigh; one very broad splint of deal, hollowed out and well covered with wool, rag, or tow, should be placed under the thigh, from above the trochanter, quite below the knee; and another, somewhat shorter, should extend from the groin to below the knee on the inside, or rather in this posture on the upper side. The bandage should be of the eighteen-tail kind; and when the bone has been set, and the thigh well placed on the pillow, it should not, without necessity (which necessity in this method will seldom occur), be ever moved from it again, until the fracture is united; and this union will always be accomplished in more or less time, in proportion as the limb shall have been more or less disturbed.

Here only two splints are mentioned; but the few surgeons who still adopt this method, usually employ four. After placing the patient in the above position, the necessary extension is to be made. Then the under splint, having upon it a broad soft pad, and an eighteen-tailed bandage, is to be laid under the thigh, from the great trochanter to the outer condyle. The surgeon, before applying the soap plaster, laying down the tails of the bandage, and putting on the other three splints, is to take care that the fracture lies as evenly as possible.

In the foregoing observations, we find Pott directing the leg and foot to be rather higher in their level than the thigh; with what particular design, I have not myself been able to make out. Whoever meditates upon the consequence of elevating the leg and foot above the level of the thigh, in the bent position, will know, that it is to twist the condyles of the os femoris more outward than is natural. When a patient is placed, according to Pott's direction, upon a common bed, the middle soon sinks so much that the leg becomes situated considerably higher than the thigh, and I am disposed to think, that this is one cause why so many broken thighs were formerly united with the foot permanently distorted outward. The great propensity of the adductor and other muscles to produce this effect, may also serve to explain the frequency of the deformity. It is not merely the depression of the middle of the bed which is disadvantageous: as the weight of the patient's body falls more upon one side of the bed than the other, in this position of the limb, unless the sacking be tight and the mattress very firm, it happens that such a declivity is formed, as to render it exceedingly difficult, if not impracticable, to make the patient continue duly upon his side. Hence, fractured thighs should always be laid upon beds not likely to sink much. When this happens, no rational dependence can be put in the efficacy of the bent position, and, as Desault has explained, the same thing is hurtful also in the straight posture.

Pott's position certainly leaves the leg and foot too moveable and unsupported, and, though it may relax the muscles, which have the greatest power to disturb the coaptation of a fractured thigh, it leaves a mass of muscle unrelaxed, quite sufficient to displace the ends of the bone. Hence, practitioners should endeavour to improve the apparatus employed, so that it may make a permanent resistance to the action of the muscles, and in the straight position such resistance may undoubtedly be made to operate with most effect and convenience.

In the early editions of this Dictionary, I expressed a preference to Pott's method of treating broken thighs. More experience, however, made me a convert to the sentiments of Desault on this subject. The terrible compound fractured thighs, which I had under my care in the campaign in Holland in the year 1814, could not have been at all retained by any apparatus put merely upon the thigh itself. The superiority of long splints, extending the whole length of the limb, was in these cases particularly manifest. With such splints, which maintain steady the fracture itself, the knee, leg, ankle, and foot, the patient may, in fact, even be removed upon an emergency from one place to another, without any considerable disturbance of the broken part. But, how could this be done in Pott's position, with short splints, merely applied to the thigh, affording no support to the leg, and not confining the motions of the knee and foot?

It was observed by Desault, that, if we compare the natural powers of displacement with the artificial resistance of almost every apparatus, we shall find, that the disproportion between such forces is too great to let the former yield to the latter. The action of the muscles, however, which is always at first very strong, he conceived might afterwards be gradually overcome by extension being kept up. A power incessantly operating can effect what another greater power, temporarily applied, cannot at once accomplish, and the compression of circular bandages tends also to lessen the force of the muscles.

Desault cured an immense number of fractured thighs, without any kind of deformity. This success was chiefly ascribed to the well-combined employment of extension and compression of the muscles. The advantage of keeping the muscles a long while extended, in order to diminish their power, seemed to him particularly evident in the reduction of certain dislocations, as those of the shoulder, in which we often cannot succeed till the muscles have been kept on the stretch for a greater or lesser time. The fracture of the patella and olecranon equally demonstrates the utility of compression for the same purpose; as, when the muscles are not steadily compressed by the bandage, they draw upward the fragment of bone with double or triple force.

To the treatment of fractured thighs in the bent posture, Desault entertained the following objections: the difficulty of making the extension and counter-extension, when the limb is so placed; the necessity of then applying them to the fractured bone itself, instead of a situation remote from the fracture, as, for example, the lower part of the leg; the impossibility of comparing with precision the broken thigh with the sound one, in order to judge of the regularity of its shape; the irksomeness of this position long continued, though it may at first seem most natural; the inconvenient and painful pressure of a part of the trunk on the great trochanter of the affected side; the derangement, to which the limb is exposed when the patient has a motion; the difficulty of fixing the leg firmly enough to prevent the effect of its motion on the thigh-bone; the manifest impossibility of adopting this method, when both thighs are fractured; the unfavourable results of the trials of such posture made in France; and, what is gained by the relaxation of some muscles, is lost by the tension of others.

According to Desault, an apparatus, which does not execute permanent extension, may suffice for transverse fractures; but is always ineffectual, when the division is oblique, because it does not fulfil the twofold indication of drawing downward the lower end of the fracture, and keeping the other one upward. He inculcated, that the object, particularly to be aimed at, was such a disposition that the foot, leg, thigh, and pelvis, should constitute but one whole; so that, though the different parts thereof might be drawn in different directions, yet they would still, with respect to one another, preserve the same mutual relation; and he invented the following apparatus to answer these purposes. A strong splint, long enough to extend from the crista of the os ilium to a certain length beyond the sole of the foot, and rather more than two inches and a half broad, with each of its extremities pierced in the form of a mortise, and terminating in a semicircular niche, is a principal part of Desault's apparatus. It is applied to the exterior side of the thigh, by means of two strong linen rollers, each more than a yard long. The middle part of one roller is applied to the inside of the thigh, at its upper part; its ends are brought to the exterior side of the thigh, passed through the mortise, and knotted on the semicircular niche. Pads are to be previously placed under its middle part, in order to prevent any disagreeable pressure; as well as on the tuberosity of the ischium, which Desault considered as the principal point of action of this band. The inferior part of the leg is next covered with pads, on which the middle part of the second roller is placed, the extremities of which cross on the instep and upper part of the foot, then on the sole; after which they are conveyed outward, and one end passed through the mortise, and knotted with the other on the niche, with such a degree of force as to pull the inferior portion of the femur downward, and push the splint upward, and, by this means, the pelvis, and superior portion of the fractured bone. On the internal side of the limb is placed a second splint, which extends, from the superior part of the thigh, to a certain distance beyond the foot. A third is placed on the anterior part of the limb, from the abdomen to the knee. The superior extremities of the anterior and exterior splints are fixed by means of a bandage passed round the pelvis. A roller, the middle part of which is placed under the sole of the foot, and the extremities crossed on its superior surface, and fastened to the splints, operates with them in preventing the foot from moving.

Before applying the apparatus, Desault covered the whole limb with linen, wetted with a solution of the acetate of lead. Over these, Scultetus's bandage was put, and a roller round the foot, all wetted with the same lotion. (See *Parisian Chir. Journal*, vol. i. *Œuvres Chir. de Desault, par Bichat*, t. i. *Rosalino Giardina, Memoria sulla Fratture, con alcune Modificazione all' Apparato di Desault*. 8vo. Palermo, 1814. *Boyer, Maladies Chir.* t. iii.)

In University College Hospital, Desault's method, somewhat modified, and in particular without the employment of the wetted many-tailed bandage, is commonly preferred. Dr. Houston, who is an advocate for the same practice, has lately published some interesting cases and observations, relative to the treatment of fractures generally, and in particular to the question concerning the advantages of one kind of posture over another. Dr. Houston conceives, that they will tend to settle what is the best mode of preventing early spasms, pain, and fever, and of securing for the patient, after the cure, the most seemly and useful condition of the limb; whether that of leaving the broken bone, during the first day, in the predicament in which it has been thrown by the accident, or that of bringing about, and securing, by artificial means, the proper apposition of the fragments, is the more likely to accomplish these objects. He believes, also, that they will enable us to draw a comparison between the advantages of the flexed and straight postures. It appears to him, that no advantage whatever is gained by leaving the ends of a broken bone in any manner out of place. The excuse for this practice, founded on the doctrine of relaxing the muscles to prevent, or relieve spasms, he regards as completely erroneous; and, he insists upon the fact, that relaxation of the muscles, which have a tendency to spasmodic contraction, excites and promotes it; whilst, on the other hand, extension, or stretching of the same muscles, is the most likely means of averting or subduing the spasm. In the spasmodic action of the gastrocnemius, which follows over-exertion of it, he observes, relief is sought in an attempt at elongating the muscular fibres by stretching out the heel. A person in bed, seized with such cramps, will press the heel of the affected limb against the footboard, or get out of bed, in order to accomplish more effectually the same object, by standing with the heel on the ground. In this case, says Dr. Houston, it is obvious, that the relaxation of the muscle is favourable to the occurrence of spasm, and that extension constitutes a means of relief. The primary cause of spasms of the muscles in fractures he conceives to be the loosening of one or other of their fixed points of attachment; and he thinks it not likely, that, by leaving them in the loosened state, or by giving one set of muscles a greater degree of relaxation than another, a check will be given to irregularity in their movements. On the contrary, it appears to Dr. Houston, both from an examination into the laws of muscular contraction, and from observations of the phenomena, which occur in other cases of disease, as well as in fractures, that the more completely the muscles are extended in length, and secured by their extremities to unyielding points, the less will be their disposition to spasmodic action. The practice of placing a broken limb in the bent posture, does not appear to Dr. Houston the most calculated to avert or check spasms; for, by such posture, the most powerful set of muscles, the flexors, seem to him to be brought into a condition "favouring the energy of their contraction;" whilst the influence of the extensors, in counteracting the effects of such contraction, is weakened nearly in the same degree.

Moderate soft pressure on the surface of a fractured limb, appears to Dr. Houston to assist in the prevention of cramps in the long muscles, "on the same principle, that proper fixtures for the attachment of their distal extremities contributes to that effect. Such pressure may exert its beneficial influence in controlling any irregular action in the muscles, by numbing their sensibility, and producing in them a certain amount of fatigue, which weakens their powers of contraction, as well as by propping together, and keeping steady the broken fragments of the bone." (See *Dublin Journ. of Med. Science*, vol. viii. art. 19.)

Dr. Houston's views of the physiology of muscular action, with reference to fractures of the extremities, make him an advocate for the extended posture, accompanied, if necessary, with extension. The cases, which he has published, are brought forward to prove the efficacy of this practice in preventing the occurrence of spasms, inflammation, and fever; and some of them to exemplify its utility even when circumstances have prevented its adoption, until after the coming on of these symptoms. Dr. Houston finds, that the patient "becomes sooner reconciled to the bed in this posture, than in the flexed one; he can be shifted more readily, so as to vary the points of contact between his body and the bed, and thereby save himself from excoriations, or sloughing of any part; and he can assume the sitting posture, and maintain it with less fatigue, for a considerable time. A better judgment may be formed of the length and shape of the broken limb, by its admitting of a comparison with the sound one; the limb can be kept more steady; and extension, if necessary, can be more readily and effectually practised." (*Houston*, vol. *cit.* p. 489.)

The *double-inclined plane* does not appear to Dr. Houston exempted, in any considerable degree, from the ordinary inconveniences, attendant on any other plan of treatment, which has for its object the principle of relaxation, or flexure of the limb; "whilst it is almost totally useless, as a means either of effecting elongation of a shortened bone, or of giving, in many cases, steady support to the member. Besides, it throws the weight of the body so completely on one part of the buttock, and by its bulk and shape so deprives the patient of the means of relieving himself from such injurious pressure, that excoriation and sloughing of the hips are frequent consequences of its use." (p. 490.)

Dr. Houston also objects to the double-inclined plane for fractures of the thigh, because it has no provision "by which the upper fragment may be steadied against the lower, especially in cases where the lesion in the bone has taken place near the trochanters. The lower piece, together with the knee and leg, are immoveably fixed, whilst the upper is left in such a predicament, that the least movement of the buttocks bends it from side to side, and rubs and twists its broken surface against that from which it has been detached. There is no provision in the inclined plane, by which the upper part of the thigh, when bent upon the pelvis, can be secured against the motions communicated to it by that part, such as may be effected in the extended posture by long splints and pads, passing up on the inside close to the perineum, and on the outside, as far along the body as may be thought necessary, securing, thereby, all the parts, so that, in any movement which is made, all must go together, as if they were one solid piece." (Vol. *cit.* p. 492.)

The usual objections to the straight posture in fractures just below the trochanters, on account of the tendency of the upper fragment to be pulled forwards by the psoas and iliacus muscles, were not exemplified in one of the cases of this description, the particulars of which are given by Dr. Houston. "The projection forwards of the upper piece, so remarkable in the first days after the accident, gradually subsided, under gentle pressure on the forepart of the thigh, and the bones finally assumed their natural points of connexion with each other. By the adoption of the extended posture, with the aid of extension, that deformity, so common in fractures of the thigh, permanent eversion of the toes, and I believe also, that of shortening of the limb, will be more probably everted, than can be done under the best directed efforts of the double-inclined plane." By the same plan, likewise, Dr. Houston observes, that pain and excoriation of the heel may be easily prevented, if a narrow pad be laid between the limb and bed, a little above the heel. The apparatus, which this gentleman employs for fractures of the lower extremities, is a modification of that recommended by Desault, and consists of a tailed bandage, two long lateral splints, and splint-cloth, two calico bags containing bran, and broad straps with buckles, together with a footboard, and, if necessary, lacs of calico for the purposes of extension. "The tails of the bandage may be two inches and a half broad, and about two feet long. They should be applied neatly around the limb, with due regard to lightness. The application of this bandage tends to steady and support the muscles, and, if much inflammation be present, it may, when very lightly applied, be of use in conveying discutient washes. In a case of compound fracture, the bandage may be left out to facilitate the discharge of matter, and to permit the application of poultices or dressings, without disturbing the other parts of the apparatus. The splints may be made of deal, of sufficient thickness to prevent their bending, and from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches in breadth, according to the thickness of the limb to which they are to be applied. They should be of equal breadth, as otherwise the limb will turn to the side of the narrow one. In case of necessity for permanent extension, the external splint should be made, as directed by Desault, with a hole and notch at either end, by which to fasten the lac; and it will be advantageous here to have this splint of sufficient length to mount well up along the side of the abdomen, as the higher the point, to which the lac is fastened, the more effectually will the extension be exerted in the axis of the limb." Dr. Houston prefers pads of linen, or calico, filled with bran, and about one third broader than the splints. If permanent extension be necessary, the upper lac, or band for counter-extension, he recommends to be filled in a baglike form with bran, in order to prevent excoriation of the groin. The ends of this lac should be long enough to be carried round the abdomen, after being fastened to the top of the splint, by which means the splint will be effectually secured to the side. In order that the extension of the lower end may be made as much as possible in the line of the axis of the limb, Dr. Houston deems it advantageous to draw the lac through a hole or slit in the centre of the footboard, which will thereby serve as a pulley to give the lac a perpendicular direction, before it is turned towards the extremity of the outer splint, to which it is to be fastened. A piece of leather, introduced between the ankle and the lac, will save the skin from the injurious effects of pressure. The lac may consist of a long strip of calico, doubled up several times into a breadth of about an inch and a half, and smoothed so as to make it lie flatly. The mode of its application may be that usually practised for the reduction of dislocations, by which extension is made equally from both sides of the limb. For other particulars, the reader is referred to Dr. Houston's paper. (See *Dublin Journ. of Med. Science*, vol. viii. art. 19.)

Thus, we find, that Dr. Houston's principles and practice, in relation to fractures of the thigh, are as opposite as possible to those of Pott, and coincide very closely with those of Desault. As no posture will hinder the muscles from displacing the ends of the fracture, I have always recommended that to be generally preferred, in which the most efficient mechanical aid can be employed. The position chosen by Pott, I have therefore long abandoned, and tried sometimes a slightly flexed position, on a well made double-inclined plane, with footboard, and pelvis and thigh straps; but, of late, still more frequently, the straight position. During the first year after the opening of University College Hospital, I tried both plans promiscuously, and nearly every case terminated without deformity; but, as the patients in the straight position appeared to suffer least inconvenience, I have since commonly preferred it. With regard to Dr. Houston's observation, that the double-inclined plane cannot be made to "bind the pelvis and broken fragments together as one piece, only moveable together," it cannot apply to one of proper construction, like that of Amesbury, with a pelvis and thigh strap. I have now a woman under my care in University College Hospital, whose thigh-bone is broken close below the trochanter minor. The extended position was tried for the first few days;

but, as the upper fragment continued to project considerably forwards, the slightly flexed posture, on a double-inclined plane, with a pelvis strap, was adopted; and the ends of the fracture were then kept together without difficulty; and the union of them has taken place very favourably. As for fractures of the leg, the relaxation of the powerful muscles of the calf, seems to me so advantageous in the reduction and subsequent management of these accidents, that I apprehend it will never be renounced, whatever may become the general practice with regard to fractures of the thigh.

Fractures of the femur, near the knee, are recommended by Sir Astley Cooper to be treated in the extended position, with lateral splints.

Instead of the position advised by Pott, or that recommended by Desault and Boyer, some surgeons prefer the posture, in which the patient lies upon his back, with the limb supported in the bent attitude by means of a wooden frame. This machine, in its most simple form, consists merely of boards, ten or eleven inches in breadth, one reaching from the heel to the ham, the other from the ham to the tuberosity of the ischium. Under the knee-joint, they are united at an angle, while a horizontal board connects their lower ends together. Thus they form two sloping surfaces, to which cushions are adapted, and over which the limb can be placed in an easy bent position. Near the edge of the inclined boards, holes are made, furnished with pegs. After the bone has been set, a long splint is applied from the hip to the side of the knee, and another along the inside of the thigh. (See *Sir Charles Bell's Operative Surgery*, vol. ii. p. 189.) The foregoing apparatus does not sufficiently secure the leg and foot from motion, though, with the aid of a roller and a footboard, this advantage might easily be obtained. At present, therefore, the oblique planes of Amesbury and M'Intyre are generally preferred, which are more complete, admit of being placed at any angle, and fulfil their purpose with greater efficiency, particularly when the pelvis and thigh straps are employed. Indeed, whatever apparatus be applied, or whatever posture be chosen, the pelvis strap is a most important thing, if the fracture be high up; and without its assistance, as Dupuytren justly remarks, the patient cannot be cured without deformity. (*Clin. Chir.* t. i. p. 333.) The fracture bed, devised by my friend Mr. Earle, is excellently calculated for this mode of treatment, and has a contrivance, by which the patient is enabled to have stools, without moving himself or changing his posture in the slightest degree. (See *Earle's Practical Obs. in Surgery*, p. 125, &c. 8vo. Lond. 1823.)

Fractures of the Neck of the Thigh-Bone.

As this is a subject which has of late years excited considerable discussion, the reader cannot be too particular in noticing, that three distinct kinds of fracture, very different in their nature, treatment, and result, have been generally confounded together under the name of "fractures of the neck of the thigh-bone;" for, much of the dispute, that has prevailed, whether these fractures will unite like those of other bones, seems to have proceeded from the three species of fracture not having been properly discriminated. Two of the cases unite by means of callus, like other fractures; but, the other, as it usually occurs, is conceived by some surgeons not to admit of a similar mode of union; or, at all events, they declare that such a termination is very difficult to procure. Sir A. Cooper has, therefore, divided these cases, first, into *fractures, which happen through the neck of the bone, entirely within the capsular ligament*; being the examples, in which a union by bone had not, some years ago, presented itself to his notice: secondly, into fractures through the neck of the bone *at its junction with the trochanter major, which fractures are of course external to the capsular ligament*: thirdly, into *fractures through the trochanter major, beyond its junction with the neck of the bone.* (*On Dislocations, &c.* p. 114—116.)

Fractures of the neck of the thigh-bone are infinitely more frequent than dislocations at the hip, and may arise from a fall, either upon the great trochanter, the sole of the foot, or the knee. According to Desault and Dupuytren, the first accident produces the injury much more frequently than the two latter. (*Clin. Chir.* t. ii. p. 90. 93.) The causes are arranged by Dupuytren, according to their greater frequency, as follows: 1. Falls on the great trochanter. 2. Direct violence, as that from gunshot. 3. Falls on the foot or knee. 4. Muscular action, as reported of a negro afflicted with tetanus. Of thirty cases, which were seen by Desault, four and twenty arose from falls on the side of the pelvis. All those, inserted by Sabatier in his interesting Memoir, were the result of a similar accident. In three or four examples, Dupuytren found the acetabulum fractured and forced inwards by the head of the femur, by a fall on the feet or knees. In the most remarkable of these cases, the uninjured head of the thigh-bone had passed entirely into the pelvis; and the neck, which was free from fracture, was so firmly wedged in the opening, that the reduction of this new species of dislocation was exceedingly difficult, even in the dead subject. In children, force, directed against the bottom of the acetabulum, may disjoin the pieces of the os innominatum combining to form it. (See *Dupuytren, Clin. Chir.* t. ii. p. 110.) Sir Astley Cooper observes, that, in London, the fracture within the capsule is most commonly produced by a person slipping off the edge of the footpavement. He admits, however, that the accident is frequently caused by a fall upon the trochanter major. (*Surgical Essays*, part ii. p. 35, 36. Also *Larrey, Journ. Complém.* t. viii. p. 98. 8vo. Paris, 1820.) Dupuytren, and all surgeons of experience, recognise the truth of the remark made by Sir Astley Cooper, namely, that a fracture of the neck of the thigh-bone, within the capsular ligament, seldom happens but at an advanced period of life; and the reason of the facility, with which the injury takes place in old persons, he ascribes to the interstitial absorption, which that part of the femur undergoes in individuals past a certain age, whereby it becomes shortened, and altered in its angle with the shaft of the bone. Dupuytren never had a case of fracture of the neck of the femur in a child, and he notices the great rarity of such an accident in young persons. (See *Clin. Chir.* t. ii. p. 82.) He refers, however, to one example in a boy, aged 15, as recorded by Sabatier. (*Mém. de l'Acad. Royale de Méd.*) Another, I think, has been published by Mr. Stanley. (See *Méd. Chir. Trans.*) Possibly some cases, supposed to have been fractures, might have been separations of the epiphyses. (See *Dupuytren, Clin. Chir.* t. ii. p. 90.) Fractures of the neck of the thigh-bone, within the capsule, are more common in women, than men. (*J. Wilson on the Skeleton, &c.* p. 245. *A. Cooper on Dislocations, &c.* p. 122.)

Almost all the patients under Dupuytren, in the Hôtel Dieu, with fractures of the neck of the femur, were more than fifty years of age; and, he found the frequency of the accident increase with old age. The reason of the rarity and frequency of the accident at different periods of life, is correctly ascribed by him to the anatomical disposition of the parts, which is not the same in different ages and in both sexes. In childhood, the axis of the neck of the thigh-bone approaches that of the shaft; and the great trochanter forms but a slight prominence. Falls on this process were observed by Dupuytren to be the most common cause of the accident; and the frequency of the injury he found to be in a direct ratio to the degree of prominence of the great trochanter, or dependent upon the length of the neck of the bone, and the angle formed by it with the shaft. In children, the trochanter projects but little, being concealed under the prominence of the os innominatum. Hence, in falls upon the side of the pelvis, the violence does not operate upon it. Dupuytren notices, in addition to the above facts, the greater flexibility of the neck of the femur in a child; the diminutive breadth of the pelvis; and the abundance of adipous cellular tissue protecting the great trochanter.

In adults, under a certain age, fracture of the neck of the thigh-bone is rare, yet less so than in children. The phosphate of lime, as Dupuytren observes, has accumulated in the skeleton, though not so copiously as in old subjects; the neck of the femur is much longer; the angle formed with the body considerably more marked; consequently a greater projection of the trochanter, and an increased facility for the operation of the causes productive of fracture of the neck, whether they act from below upwards, or from above downwards. But, as Dupuytren further explains, this length of the neck of the bone, and projection of the great trochanter, differ according to the period of life, the sex, and the individual. In women, the neck of the femur is longer, the great trochanter more prominent, and consequently the frequency of fractures of the former parts greater, than in men. The bulk and fulness of the muscles, which deaden the effect of falls in male adults, of course lessen the frequency of these fractures in him; while, on the other hand, the accident is common in those male adults, whose conformation approximates to that of women in the breadth of the pelvis, the length of the neck of the femur, and the projection of the great trochanter. (See *Dupuytren, Clin. Chir.* t. ii. p. 83—86.)

Dupuytren adverts also to the generally greater quantity of subcutaneous fat in women, than in men, as diminishing the effect of falls on the great trochanter; but, when the emaciation is equal in both sexes, the anatomical circumstances above mentioned, he says, must render women more liable than men to fracture of the neck of the femur.

In advanced life, the pelvis retains its extreme width, the great trochanter is prominent, the neck of the femur inclined to a right angle, the organised substance of the bones lessened, and the phosphate of lime so redundant as to render the bones very brittle. These circumstances, together with the diminished quantity of adipous cellular tissue, and the flaccidity and atrophy of the muscles, account for the frequency of the accident in old men.

The circumstances enumerated by Dupuytren, as making women of advanced age more liable to this fracture, than men, are the following: the greater length of the neck of the thigh-bone; its lesser obliquity in relation to the shaft; the greater projection of the trochanter major, and the greater brittleness of the osseous texture, in the former, than the latter. In aged women, also, there is frequently considerable emaciation. (See *Clin. Chir.* t. ii. p. 87.)

The division is more frequently transverse than oblique; the neck being sometimes, in the former case, wedged in the body of the bone, as Desault found in several instances; a model of one of which, in wax, is preserved at Paris, and the natural specimen of which was in the possession of Bichat. A fracture of the neck of the thigh-bone is sometimes complicated with one of the trochanter major.

With respect to the diagnosis of a fracture within the capsular ligament, an acute pain is felt, a sudden inability to walk occurs, and the patient cannot raise himself from the ground. The latter circumstance, however, is not invariable. In the fourth vol. of the *Mém. de l'Acad. de Chirurgie*, a case is related, in which the patient walked home after the accident, and even got up the next day. Desault published a similar example; and several others fell under the observation of Dupuytren. (See *Clin. Chir.* t. ii. p. 96.) The locking of one end of the fracture in the other, affords an explanation of this circumstance.

The diagnosis is not always free from considerable difficulty: some individuals have the rational signs of the accident, and yet are not the subjects of it; while others, who have really encountered it, may not exhibit the symptoms of it. Sometimes a fall producing a contusion of the hip will bear some resemblance to a fracture of the neck of the femur, while the same cause occasioning the latter injury, may not hinder the patient from getting up and walking. Dupuytren concurs with other surgeons in ascribing this fact to the fracture being situated within the capsular ligament, and the fragments not being displaced, but the lower wedged in the upper. Then the circumstances of their becoming separated after a longer or shorter time, and of the fracture then being rendered manifest, he imputes to the fragments changing their situation with respect to one another, either in consequence of the weight of the body, the action of the muscles, or the removal of some portion of the fragments themselves. I think, however, with Mr. R. W. Smith, that it is more frequently owing to the fibrous covering of the neck giving way after a certain time (see *Dubl. Journ. of Med. Science*, vol. vi. p. 213.); and his observation seems well founded, that a sudden retraction, at a period more or less remote from the receipt of the injury, denotes a fracture within the capsule. The shortening and rotatory displacement of the limb, arising from the displacement of the fragments, then leave no doubt of the fracture, provided they are connected with no other cause than a fall a few days previously. Sometimes, as Dupuytren adds, the two foregoing signs do not occur, till fifty, sixty, or eighty days after the commencement of the treatment by rest and extension, owing to the callus having yielded to the contraction of the muscles, or the weight of the trunk. Dupuytren further explains, that the internal fragment may be wedged in the external one, directed either forwards, or backwards; that, when it happens, the shortening of the limb is only to the extent that one fragment is impelled into the other; and that this may account, in some cases, for the occasional inversion of the foot, which is an exception to what is usually noticed. (See *Clin. Chir.* t. ii. p. 97—100.)

Another remark made by Dupuytren is perfectly correct, namely, that, when there is displacement, the nature of the accident is easily made out; but, that, when no displacement exists, a suspicion may be entertained of the fracture; yet there can be no certainty about it. When the shortening of the limb is only to the extent of a few lines, the discrimination of it from what is produced by the ascent of the pelvis from a contusion, is attended with difficulty; but the diagnosis is plainer, if the retraction amounts to half an inch, an inch, or an inch and half, or two, or three inches. The latter degrees of shortening rarely occur, but consecutively, and when the patient has attempted to walk. (*Dupuytren, Clin. Chir.* t. ii. p. 103.)

The dissections made by Dr. Colles, led to the discovery, that sometimes the solution of continuity does not extend completely through the neck of the femur. (See *Dublin Hospital Reports*, vol. ii.) Three cases proving this fact are adduced; a fact, which at once explains the ability of some patients to walk directly after the injury, and the absence of all retraction of the limb. According to Mr. Amesbury, incomplete oblique fractures of the neck of the femur are easily produced in the recently dead subject. (*On Fractures of the Upper Third of the Thigh-bone*, p. 3.)

A shortening of the limb almost always takes place; the "leg becomes," according to Sir Astley Cooper, "in a case of fracture within the capsule, from one to two inches and a half shorter than the other; for the connexion of the trochanter major with the head of the bone, by means of the cervix, being destroyed by the fracture, the trochanter is drawn up by the muscles, as high as the ligament will permit, and consequently rests upon the edge of the acetabulum, and upon the ilium above it." (*On Dislocations, &c.* p. 117.)

With respect to the degree of retraction specified by Sir Astley Cooper, as attendant on fracture of the neck of the femur, within the capsular ligament, its correctness is not admitted by some surgeons; Mr. R. W. Smith, of Dublin, declares that it is completely opposed to the result of his experience; nor does he conceive it possible, that the capsule of the hip-joint could admit of displacement to the extent of two inches and a half, without being extensively torn; an occurrence very rare indeed: and, if, as is frequently the case, the fibrous reduplications, which constitute the periosteum of the neck of the bone, remain entire, or nearly so, retraction may be almost completely prevented. In several instances of recent fracture of the neck of the femur, within the capsule, Mr. Stanley found this to be the case. (See *Med. Chir. Trans.* vol. xiii.) Mr. R. W. Smith refers also to the statements of Boyer and Earle, in support of the same view; and he adds, "But when the fracture is external to the capsule, there is an opportunity for retraction occurring to its greatest degree: there is, in fact, nothing to prevent the full force of muscular action upon the lower fragment of the bone, while, at the same time, the upper is forced downwards by the weight of the body." (See *Dublin Journ. of Med. Science*, vol. vi. p. 207.)

Mr. Smith excepts from this observation, the case in which the upper fragment is driven into the cancellated texture of the lower, the ascent of which is not only prevented, but sometimes the restoration of the limb to its original length. Here the degree of shortening will be much less than what is usually the result of a fracture external to the capsule; and this relative position of the fragments, Mr. Smith conceives, ought to be suspected, whenever unusual difficulty is experienced in detecting crepitus, and extending the limb to its original length.

Mr. Smith corroborates his remarks by a reference to fifteen examples of fracture of the cervix femoris, in the museum of Richmond Hospital. Thirteen of these are taken from patients who died in the hospital; and the degree of shortening in each case was carefully noted. With the exception of No. 9., the shortening did not exceed one inch in any case of intra-capsular fracture; and reached that extent in only one instance; nor, with the exception of No. 10., was it ever less than one inch and a half in the extra-capsular fracture. (See *Dub. Journ. of Med. Science*, vol. vi. p. 209.) With respect to No. 9., an intra-capsular fracture, in which the shortening equalled one inch and a half, the accident had occurred some years before the measurement was made, and the neck of the bone had been absorbed. In general, the degree of shortening, when the fracture is within the capsule, I believe, with Mr. Smith and others, often depends upon the extent to which the fibrous reduplications have been torn. According to this gentleman's investigations, the degree of shortening, when the fracture is within the capsular ligament, varies from a quarter of an inch to one inch; when external to the capsule, from one inch and a half to two inches and a half. At the same time, the great differences in the direction of the solution of continuity, must have, as Dupuytren has admirably explained, vast influence upon the degree of retraction, as well as upon the rotatory displacement of the limb. (See *Clin. Chir.* t. ii. p. 113.) The action of the muscles drawing upward the lower end of the fracture, the weight of the trunk in propelling downward the pelvis and upper end of the fracture, are the two causes of the shortening of the limb. In general, a slight effort suffices for the restoration of the natural length of the limb; but, the shortness recurs almost as soon as the extension ceases. "This evidence of the nature of the accident continues," as Sir A. Cooper correctly remarks, "until the muscles acquire a fixed contraction, which enables them to resist any extension, which is not of the most powerful kind." (*Surgical Essays*, part ii. p. 31.) Goursault, Sabatier, and Dupuytren found, that sometimes the shortening of the member did not take place till a long while after the accident. Dupuytren refers to examples in which several hours, and even from two to thirty days, elapsed, before any displacement of the fragments took place, and which was then produced either by the patient's own movements, or by the surgeon's examination of the part. (*Clin. Chir.* t. ii. p. 96.) In opposition to the common belief, that the limb is shortened, Baron Larrey asserts, that the member is at first actually lengthened. (*Journ. Complém.* t. viii. p. 99.) This statement I have never seen confirmed, and it is contradicted by daily experience. And, to prove how widely Larrey differs from Sir A. Cooper, the following passage will suffice. "In order to form a still more decided judgment of this accident (says the latter writer) after the patient has been examined in a recumbent posture, let him be directed to stand by his bedside, supported by an assistant, so as to bear his weight upon the sound limb. Immediately he does this, the surgeon observes most distinctly the shortened state of the injured leg, the toes resting on the ground, but the heel not reaching it, the everted foot and knee, and the diminished prominence of the hip." (*Surgical Essays*, part ii. p. 34.) The lessened projection of the trochanter major arises from its not being supported by the neck of the bone, as it always is in the natural state of the parts. A swelling is observable at the upper and front part of the thigh, always proportioned to the retraction, of which it appears to be an effect.

The projection of the great trochanter is almost effaced. Directed upwards and backwards, this eminence becomes approximated to the crista of the os ilium; but, if pushed in the opposite direction, it readily yields; and, when it has arrived at its natural level, the patient becomes capable of moving his thigh.

The knee is a little bent. Abduction of the limb always occasions acute pain, and it is noticed by Sir A. Cooper, that the rotation inwards is particularly painful, because the broken extremity of the bone then rubs against the capsular ligament. (Vol. *cit*. p. 33.) If, while the hand is placed on the great trochanter, the limb is rotated on its axis, this bony projection may be felt revolving on itself, as on a pivot, instead of describing, as in the natural state, the segment of a circle, of which the neck of the femur is the radius. This symptom, which was first particularly noticed by Desault, is very manifest when the fracture is situated at the base of the neck; less so when at its middle; and it is not very perceptible when the breach is near the head of the bone. In the rotatory motions, the lower fragment rubbing against the upper one, produces a distinct crepitus, which, however, is not an invariable symptom. In fact, as Sir A. Cooper has explained, it is not discoverable while the patient is lying upon his back with the limb shortened; but, if the leg be drawn down, so as to bring the limbs to the same length, and rotation be then performed, especially inwards, the crepitus is sometimes observed, in consequence of the broken ends of the bone being thus brought into contact. (*On Dislocations, &c.* p. 121.)

It appears to Mr. Amesbury, that the head of the bone moves so readily in the acetabulum, "that the least impetus, even through the periosteum and reflected membrane (supposing them to be entire), will cause it to move simultaneously, with the shaft; and, if it should do so in the same relative proportion, crepitus cannot be felt. If crepitus be not elicited by bending the limb upon the pelvis, the surgeon may try to produce it by causing the limb to be *gently rotated*, while he endeavours to fix the head of the bone by pressing it, with his fingers, back against the acetabulum." (*On Fractures of the Upper Third of the Thigh-bone*, p. 15.)

The toes are usually turned outward; a position which Sabatier considers as the inevitable effect of the fracture, though Paré and Petit noticed that it did not constantly occur. Two cases, adduced by these illustrious surgeons, were not credited by M. Louis; but the experience of Desault fully confirmed the possibility of inversion of the limb. As Sir A. Cooper has remarked, three or four hours generally elapse before the turning of the limb outward is rendered most obvious by the fixed contraction of the muscles. (*Surgical Essays*, part ii. p. 32.) The inversion of the limb, however, in fractures of the neck of the femur, is rare; Dupuytren, in his immense practice, never having seen it but once or twice. (*Clin. Chir.* t. ii. p. 105.) Mr. R. W. Smith has met with three cases, in one of which the injury was within the capsule. (*Dub. Journ. of Med. Science*, vol. vi. p. 215.)

Mr. Langstaff dissected a case, in which the great toe was in the first instance everted, but subsequently turned inwards when the patient began to use the limb. "The preparation shows the fracture to have been within the capsular ligament, close to the head of the bone, and gives a decided refutation to the opinion of the length of the broken portion attached to the trochanter being the cause of the inversion, inasmuch as this part has been removed by absorption. The point of the foot was everted, whilst it retained its proper length, and only became inverted by a wise provision of nature to assist progression after it had begun to be shortened. This circumstance received great illustration in the person of Henry West, a boy from whom Mr. White, of the Westminster Hospital, removed the head, neck, and part of the trochanter of the left thigh-bone, in consequence of scrofulous disease of the hip-joint, attended by abscess. He recovered after the removal of the bone. The thigh is three inches and a half shorter than the other, and the toes turned inwards, not only in walking, but when he lies on his back in a quiescent posture, or prepared for sleep." (*Guthrie, Med. Chir. Trans.* vol. xiii. p. 109.) The possibility of the foot being turned inwards directly after the accident, is the subject that now more immediately interests us. Of this occurrence an example is reported by Mr. Stanley. "A middle-aged man fell in the street, and his hip struck the curbstone. The immediate consequences were, that the limb was inverted and shortened to the extent of an inch, and no crepitus could be discovered. It was presumed that a dislocation had occurred, and accordingly an extension of the limb was made; and so great was the constitutional irritation occasioned by the repeated trials to reduce the supposed dislocation, that the man died about five months from the time of the accident. In the dissection of the hip, a fracture was found, extending obliquely through the middle of the neck of the femur, but *entirely within the capsule*. A portion of fibrous and synovial membrane on the anterior side of the neck of the bone had escaped laceration."—"In a male subject, that had been brought for dissection, it was observed, that the left lower extremity was turned inwards and considerably shortened. On examining the hip, a fracture was found, extending through the neck and shaft of the femur. The neck had been broken at its junction with the shaft, and a fracture had extended from the upper part of the trochanter major downwards at the posterior side of the femur, a little below the trochanter minor. The upper part of the shaft was thus split into two portions, one of which was of sufficient magnitude to include the trochanter minor, and nearly the whole of the trochanter major.

"In the two last cases, it may be asked, to what cause the inversion of the limb should be attributed? Whether to the direction of the fracture? If not, whether there be any other circumstance adequate to its explanation? In the instance of fracture within the capsule, the portion of the synovial and fibrous membrane which had escaped laceration on the anterior side of the neck of the bone might probably prevent the limb from being turned outwards; but (says Mr. Stanley) why it should have been turned inwards, I confess myself unable to explain. In the instance of fracture without the capsule, by considering the direction of the fracture, in reference to the attachments of the muscles, we obtain an explanation of both points. For, as nearly the whole of the muscles that rotate the thigh outwards were connected with the separated portion of bone, they must have ceased to influence the limb in one direction, and of course have left their antagonists at liberty to turn it in the other; and the fractured surfaces being permitted to unite, without any change in the position of the limb, the inversion would become permanent." (*Med. Chir. Trans.* vol. xiii. p. 508.) Respecting one part of this statement, I think with Mr. Smith (*Dub. Journ. &c.* vol. vi. p. 215.), that the circumstance of the fibrous membrane remaining entire upon the front of the neck of the bone, would scarcely account for the limb not being everted. The merit of having first explained the cause of the inversion of the foot in certain fractures on the outside of the capsular ligament is due, I believe, to Mr. Guthrie. "When (says he) the fracture has taken place in such a manner as to be external to the insertion of these rotators outwards, yet sufficiently within the insertion of the glutæus medius and minimus, so as not to deprive them of their due action, the toe will be turned inwards, and must always be so; or remain without any alteration of position, according to certain variations in the inclination of the fracture, affecting the power of these muscles." In the instance recorded by Mr. Guthrie, the little trochanter was broken off; but whether it be an essential complication, he conceives, must be determined by future observation. (Vol. *cit.* p. 112.) The principles on which this gentleman founds his explanation, have since been corroborated by the particulars of a case that was examined by Mr. Syme. (See *Edin. Med. Journ.* April, 1826.) The reason of the foot being occasionally inverted, even when the fracture is quite within the capsular ligament, still remains, however, a point in surgery requiring explanation. The eversion or inversion of the limb, Dupuytren ascribes to the obliquity of the fragments. If the internal fragment incline backward, and the external one forward, then, says he, eversion will take place; but, on the contrary, if the fracture be oblique in the inverse direction, there will be inversion of the limb. (*Clin. Chir.* t. ii. p. 109.)

Mr. Porter had an opportunity of dissecting the hip-joint, in a case where the patient, an old female, died the day after the accident. When first brought to the hospital, she could bend the knee and draw up the foot by the action of the muscles of the limb alone. Afterwards she lost this power. The limb was not shorter than the other; neither was the toe everted. At the *post mortem* examination, the limb was from a quarter to half an inch shorter than the other, and "the foot was in a state of semi-eversion." The capsule was found perfect, and, on dividing it posteriorly, a transverse fracture of the neck of the femur was detected close to the head of the bone, and, of course, entirely within the capsule. The fragments were but little displaced, *being held together by the synovial membrane and periosteum.* These latter were partially detached, and a portion of the lower surface of the neck of the bone denuded; but the fibres, removed from the bone, were gathered together into a bundle, forming a kind of ligament of a triangular shape; the bone being at the edge of the head, the apex at the point of reflexion of the synovial membrane on the capsule. *This appeared to be very tense and strong, and made considerable resistance to a separation of the fragments.* "This case is interesting, as proving, that, in fractures completely within the capsule, the limb is not at all, or but slightly, shortened; and that the chief obstacle to such shortening, is the periosteum of the neck, and the reflected synovial membrane." (*W. H. Porter*, in *Dub. Journ. of Med. Science*, vol. x. p. 243.)

The dislocation upon the dorsum of the ilium, that into the sciatic notch, and fracture of the neck of the femur, *attended with inversion of the foot*, are to be distinguished from each other, according to Mr. Guthrie, by comparison, or a due estimate of the degree of inversion. In the first case, the inversion is complete, the great toe resting against the instep of the opposite foot; in the second, it is less complete, the great toe resting against the ball of the corresponding toe of the opposite foot; and in the third, it is still less complete. And, as Mr. R.W. Smith justly observes, the nature of the injury is rendered still more evident by observing the facility with which, in the case of fracture, the foot may be everted, the thigh flexed upon the abdomen, and the limb restored to its natural length by extension; and comparing its free, loose, powerless condition, with its almost immoveably fixed state in dislocation. (See *Dub. Journ. of Med. Science*, vol. vi. p. 218.) The accident most liable to be confounded with dislocation upon the dorsum ilii, is fracture through the trochanters, with inversion of the foot. (*R. W. Smith, Op. et* vol. *cit.* p. 229.)

The ordinary position of the toes outward is commonly, and I believe correctly, imputed to the action of the rotator muscles, and the adductors. Bichat conceived, however, that, if this doctrine were true, such position ought always to exist; and he reminds us, that all the muscles, which proceed from the pelvis to the trochanter and upper part of the outer fragment, are, with the exception of the quadratus, in a state of relaxation, by the approximation of the femur to their point of insertion; and that the contracted muscles would not allow the foot to be so easily turned inward again. Hence Bichat thought it probable, that the weight of the foot itself might pull the limb into the position in which it is commonly found. On the other hand, it is remarked by Sir A. Cooper, that any one may satisfy himself that the rotation of the limb outwards is in part owing to the muscles, by feeling the resistance which is made to rotation inwards, which resistance, however, he thinks, may in some measure depend upon the length of the portion of the neck of the femur, which remains attached to the trochanter major, and rests against the ilium. (*Surgical Essays*, part ii. p. 32.)

In addition to the foregoing observations respecting the diagnosis, it is to be remembered, that a fracture within the capsular ligament seldom happens but at an advanced period of life, and is much more frequent in women than men. (*Sir A. Cooper on Dislocations, &c.* p. 123.)

The observations of Boyer, R. W. Smith, Porter, and others, prove, that a fracture of the neck of the thigh-bone, on the outside of the capsular ligament, is attended with a greater shortening of the limb than a fracture within it. A fracture on the outside of the capsule is frequently met with in persons under fifty, though it may and does occur in older subjects. Also, while the fracture within the capsule takes place from very slight causes, this is generally the result of great violence, severe blows, falls, and the passage of heavy carriages over the pelvis. The crepitus can be easily felt, without previously drawing down the limb, and the case is characterised by greater suffering than what is usually noticed when the fracture is within the capsule. But the most important circumstance, in which a fracture on the outside of the capsule differs from one within it, is in its readily admitting of bony union, which it is much more difficult to accomplish in the latter case. (See *Sir A. Cooper on Dislocations, &c.* p. 185, &c.)

In an oblique fracture through the trochanter major, without injury of the neck of the bone, the leg is very little, and sometimes not at all, shortened; the foot is benumbed; the patient cannot turn in bed without great difficulty and pain: in some cases, the detached portion of the trochanter is drawn forwards towards the ilium; in others, it falls towards the tuberosity of the ischium; but, in general, it is widely separated from that portion which remains connected with the neck of the bone. The foot is considerably turned outwards, and a crepitus not readily detected. This accident may happen at any period of life: it unites readily; and the patient recovers, with a very good use of the limb. (Vol. *cit.* p. 158.)

Many years ago, it was supposed that fractures of the neck of the thigh-bone could not be cured without some shortening of the limb, and lameness. Ludwig, Sabatier, and Louis, broached this doctrine, and imputed the circumstance to the destruction of the neck of the bone. That this commonly happens, has been well ascertained. In several specimens which Mr. Crosse examined in different museums at Paris, whether imperfect union, or no union at all, had followed the fracture, this absorption of the neck of the bone had taken place to a great extent, and in some to so great an extent, that the articulating surface of the bone which plays in the acetabulum, rested between the trochanters consolidated to the body of the bone by ligamentous, union, and the thickening of the surrounding parts, whilst all the intervening neck of the bone was absorbed. (See *Sketches of the Medical Schools of Paris, by J. G. Crosse*, p. 90.) M. Roux has also nearly always found the neck of the femur shortened and deformed after its reunion. (*Parallèle de la Chir. Angloise avec la Chir. Françoise*, p. 178.) The specimens in the museum of University College, exhibit the usual disappearance of more or less of the same part. Desault, however, in his practice, is said to have rarely met with instances of lameness from such a cause.

A question, formerly much agitated (see *Earle's Practical Obs. in Surgery*, Lond. 1823; and *Amesbury's Obs. on the Nature and Treatment of Fractures of the Upper Third of the Thigh-Bone, &c.* Lond. 1829, ed. 2.), was, whether reunion by bone ever follows *cases, in which the fracture is entirely within the capsule*, and the head of the bone insulated, except at its attachment to the acetabulum by the round ligament? Many years ago, the decision of the French surgeons was in the affirmative, and they believed the fact to be actually demonstrated by preparations in their museums. M. Roux sent a specimen to Sir A. Cooper, with the hope of producing conviction; but, this eminent surgeon was not satisfied with the evidence, because the traces of reunion in that preparation appeared to him to indicate a sort of fracture, where the internal fragment still retained some connexion with the capsular ligament. (*Roux, Parallèle de la Chirurgie Angloise, &c.* p. 179, 180.) In fact, it was a case, in which the fracture happened at the junction of the cervix with the trochanter. Sir A. Cooper never denied the possibility of what M. Roux and others alleged, but only stated, that in all the examinations which he had then made, of *transverse fractures of the cervix femoris, within the capsular ligament, he had never met with a bony union, or with any which did not admit of motion of one bone upon the other.* (*Surgical Essays*, part ii. p. 39.) Since that period, however, Sir Astley Cooper has satisfied himself that osseous union sometimes takes place, and he has in his own collection, a most unequivocal specimen of it, which he was kind enough to show to me, about two years ago. The possibility of bony union is now universally acknowledged; but the cure in this way, is far less frequent, than that by means of a ligamentous connexion. Sir Astley Cooper ascribes the common want of bony union to the fragments not being in contact, and duly pressed against each other, and to the little action in the head of the bone separated from the cervix, "its life being supported solely by the ligamentum teres, which has some few vessels ramifying from it to the head of the bone." These vessels, though neither large, nor numerous, may yet, according to Amesbury and Dupuytren, be adequate to the nutrition of the upper fragment. Besides, it is observed by Dupuytren, that the synovial membrane, which invests the cartilage, forms a little cul-de-sac at its base, and is distinctly covered by portions of reddish cellular tissue, in which there are many vessels. (See *Clin. Chir.* t. ii. p. 118.) Mr. Mayo gives two cases, exemplifying the appearances usually found on dissection; and observes, "there are features in them, which make it sufficiently clear, that the absence of bony union does not result from imperfect nutrition, or inadequate supply of blood to the separated portion." (*Outlines of Human Pathology*, p. 9.) This gentleman concurs with Dupuytren, Cruveilhier, and others, that, in the union of the shafts of long bones, the surrounding tissues take a prominent part in the act of reparation. But, in the fracture of the neck of the thigh-bone, within the capsule, these tissues are excluded by the untorn synovial and capsular membranes, from communicating with the fracture. "They are sometimes, indeed, seen to make the ordinary effort towards reparation of the adjacent fracture. Thus, a portion of an ossified provisional callus, is often met with external to the attachment of the capsular membrane to the neck of the femur. But, the effort is ineffectual; the callus cannot reach the fracture, whether it remains entirely disunited, or is glued together by an exudation from the ends of the broken bone. In the cases, in which union takes place, (continues Mr. Mayo) I believe the process of ossification to be extremely slow. Such instances occur in those only, who are not greatly advanced in life at the time of the fracture; and in whom, through the care with which the joint is kept at rest, direct union by soft substances, takes place between the separated portions. Nothing, in truth, is then wanted for the restoration of the part, but time. The connecting soft substance will certainly, in time, ossify from the adjoining bones; not rapidly, as when the process stretches onwards from a provisional callus, but slowly, as when it spreads across a cranial fissure. The reason why so few specimens are met with of united fracture within the capsule, is, that this accident commonly happens to aged people; and aged people want both constitutional power and time for that slow and difficult process of reparation, which is independent of provisional callus." (*Mayo*, ib.) For the particular appearances found in the dissection of many of these cases, I must refer to the statements of Dr. Colles (*Dublin Hospital Reports*, vol. ii.), and to Sir Astley Cooper's own account, from which it seems, that in most instances, "no ossific union is produced; that nature makes slight attempts for its production upon the neck of the bone, and upon the trochanter major, but scarcely any upon the head of the bone; and that, if any union is produced, it is by ligament only." (Vol. cit. p. 46. Also, *Mayo's Outlines of Human Pathology*, p. 9.) Mr. Wilson's observations are all in support of the same explanation (*On the Skeleton*, p. 247.); and he adverts to two preparations in the museum of the College of Surgeons, which were supposed to be proofs of a bony reunion of the neck of the femur, subsequently to a fracture within the capsular ligament; but (says Mr. Wilson), "I have very attentively examined these two preparations, and cannot perceive one decisive proof, in either, of the bone having been actually fractured." One of these cases was published by Mr. Liston, in the *Edin. Med. and Surgical Journ.* Lastly, Dr. Colles of Dublin dissected several cases, in which the neck of the femur had been broken: in one, where the injury was within the capsular ligament, "no effort of nature had been made to create a reunion between the two pieces of the fracture, and *the stability of the limb had depended upon the strength of those ligamentous bands, by which each piece was connected with the capsular ligament of the joint, aided, no doubt, by the extraordinary thickness which the capsular ligament had acquired.*" (*Dublin Hospital Reports*, vol. ii. p. 336.) In the two first instances, reported by this author, "The broken surfaces moved on each other, and were converted into a state approaching to ivory. No attempt had been made to reunite the fracture, and the pieces of bone were held in apposition only by new ligamentous productions from the capsular ligament, which were inserted into the external surfaces of each piece. In No. 3. there had been a slight attempt made at reunion. In Nos. 7, 8, and 9. we observed *a phenomenon, which*, I believe, *is now for the first time mentioned, a fracture of only part of the bone.* No. 6. presented us with that mode of reunion, which some have supposed the most perfect, of which this fracture is susceptible. While Nos. 10. and 11. exhibit a mode of reunion very little inferior to callus in point of firmness, but very different in its nature, and which, I conceive, is peculiar to the fracture of the neck of the femur." Dr. Colles also found, that, in all these cases (except, perhaps, No. 5.) the *capsular ligament was not lacerated.* In every instance, however, there was an *increased thickness of the capsule*, and *a removal of all*, or *the greater part, of the neck of the bone.* "Although the ligamentous bands seem, in a majority of instances, to have proceeded from the capsular ligament, yet, it is evident from No. 6. that these may arise merely from the broken surfaces of the bone; for, in this case not a single fibre was attached to the capsular ligament, the new bond of union being covered by the reflected portion of the synovial membrane or periosteum of the neck. We have an illustration of this in Ruysch, tab. 1. Thes. 9." In Nos. 10. and 11. the fragments were united by a cartilaginous substance. In Nos. 7, 8, and 9. the unbroken portion of the neck was so softened, that it more resembled cartilage than bone, and, in this state, "it was laid down upon the fractured surface, and united to it." (*Dr. Colles*, in *Dublin Hospital Reports*, vol. ii. p. 353—355.) In the museums at Paris, are some preparations, which the professors used to exhibit at their lectures, in order to prove that bony union may succeed a fracture within the capsule. These specimens were carefully examined by Mr. Crosse, but none of them proved to him, that bony union ever follows where the head of the bone becomes insulated, excepting at its attachment to the pelvis by the ligamentum teres. (*Sketches of the Medical Schools at Paris*, p. 93.) On the other hand, Boyer observes, that experience fully proves the possibility of uniting such fractures of the neck of the thigh-bone, as are situated within the capsular ligament; but, he acknowledges, that there are certain circumstances, which may prevent this desirable event. "From all that has been hitherto said on the prognosis of a fracture of the neck of the femur, we may conclude (says Boyer) that this fracture is more serious than that of any other part of the same bone, because the difficulty of keeping it reduced is greater. That it may in general be reunited, especially in young healthy subjects (in whom, however, be it observed, the accident hardly ever occurs); but, more easily, when it is situated near the base of the neck, than near the head of the bone. That the languid vitality of one of the fragments, and the impossibility of ascertaining whether the coaptation be exact, make the cure slow, and the time necessary for their consolidation uncertain. That the neglect of means adapted to maintaining the limb in its proper length and natural straightness, and the fragments sufficiently motionless, may cause them to unite by an intermediate substance. Lastly, that the situation of the fracture near the head of the femur; *the complete laceration of the elongation of the capsule investing the neck of the bone;* the great age of the patient; and, particularly, the constitution labouring under some diathesis, which affects the osseous system; may render the cure absolutely impossible: *that, in this circumstance, one of the fragments is more or less destroyed by the friction of the other against it*, and in the joint a disease is formed, which tends to carry off the patient." (*Mal. Chir.* t. iii. p. 284.)

Boyer lays much stress on the complete laceration of the continuation of the capsule over the neck of the bone, as an occurrence preventive of union. But, he thinks, it does not frequently happen, because the capsular ligament hinders much displacement of the fragment. (*Op.* cit. p. 278.) As for Baron Larrey, he entertains no doubt of the possibility of uniting fractures of the neck of the femur within the capsular ligament, and concludes his tract on this subject with the case of General Fririon, who was perfectly cured after an injury of this description. (See *Journ. Complém.* tom. viii. p. 148.)

After the very numerous and careful dissections performed by Sir A. Cooper and Dr. Colles, with the view of ascertaining the state of the joint, after fractures of the neck of the thigh-bone, little doubt can be entertained, that where the fracture is *transverse*, and *within the capsular ligament, a bony reunion, though not impossible, is at least so rare an occurrence as not to be calculated upon.* Those who look upon it as a thing more frequent and easy of accomplishment, have probably not duly discriminated from the foregoing kind of case, either fractures extending more or less in the direction of the axis of the neck of the bone, or other fractures external to the capsular ligament. How much, however, the safety of a practitioner's reputation will depend upon the prognosis which is given, must be quite evident; for in *the transverse fracture within the capsule, lameness is almost sure to follow, though its degree cannot at first be exactly estimated.* (*Sir A. Cooper, Surgical Essays,* part ii. p. 51.)

So far as I am able to judge, Sir Astley Cooper has been the means of introducing a great deal of discrimination into this subject, and, without his able exertions, the important differences in the nature, symptoms, and curableness of the various kinds of fractures of the neck and upper part of the thigh-bone, depending upon their exact situation and direction, might yet have continued very imperfectly comprehended. This remark is made, without any intention of deducting from the merits of Desault, Platner, and Mr. John Bell, all of whom long ago expressed their opinion, which, as we know, extends rather beyond the bounds of accuracy, that a fracture within the capsular ligament would not admit of union by callus. (*C. Bell on Injuries of the Spine and Thigh-Bone,* 4to. Lond. 1824. p. 52, &c.)

Mr. Amesbury believes, that all fractures of the neck of the thigh-bone admit of union, whether they be situated quite within the capsular ligament or not, and whether the reflected portion of that ligament be ruptured or not; and he ascribes the usual want of success, not to the nature of the injury, not to the insufficient circulation in the pelvic portion of the bone, but to the imperfection of the mechanical means employed in the treatment. As, however, the important point under consideration, namely, whether transverse fractures of the neck of the femur, situated entirely within the capsular ligament, admit of bony union, is one that can only be determined by experience, Mr. Amesbury follows up his arguments by a reference to several cases.

The first case adduced was under the care of Mr. Cribbe of Holborn, and is described by Mr. Langstaff, who has the preparation: "The woman was about 50 years of age when the accident occurred. The foot was everted, and there was shortening of the limb at this time; and, after death, it was shorter than the other full two inches and a half. She was confined to bed nearly twelve months: during the remainder of her life, which was ten years, she walked with crutches. This (says Mr. Langstaff, alluding to the preparation) is a specimen of fracture of the neck of the thigh-bone within the capsular ligament: the principal part of the neck is absorbed; the head and remaining portion of the neck were united principally by bone, and partly by a cartilaginous substance. The capsular ligament was immensely thickened, and embraced the joint very closely. The cartilaginous covering of the head of the bone and acetabulum had suffered partial absorption; the internal surface of the capsular ligament was coated with lymph. On making a section of the bone, it was evident that there had been *a fracture of the neck within the capsular ligament, and that union had taken place by osseous and cartilaginous media.*" (See *Med. Chir. Trans.* vol. xiii.) Mr. Amesbury then adverts to Dr. Brulatour's case, reported in the same volume of the latter work. The patient, Dr. James, died about nine months after the injury. The following appearances presented themselves. 1. The capsule a little thickened. 2. The cotyloid cavity sound. 3. The interarticular ligament in a natural state. 4. The neck of the femur shortened: from the bottom of the head to the top of the great trochanter was only four lines, and from the same point to the top of the small trochanter six lines. 5. An unequal line surrounded the neck, denoting the direction of the fracture. 6. At the bottom of the head of the femur, and at the external and posterior part, a considerable bony deposit had taken place. A section of the bone was made in a line drawn from the centre of the head of the femur to the bottom of the great trochanter, so as perfectly to expose the callus. The line of bone, indicated by the callus, was smooth and polished as ivory. The line of callus denoted also, that the bottom of the head of the femur had been broken at its superior and posterior parts.

In another example, communicated to Mr. Amesbury by Mr. Chorley, of Leeds, a gentleman died twelve months after the accident, and, on examining the hip, the synovial covering was found united with the shortened neck of the bone nearly at the head. Here nature had also thrown out broad ligamentous bands, one on each side of the joint. They were firmly united to the head of the bone. When the soft parts had been removed, the head of the bone was seen depressed in a line with the shaft. The fracture was slightly oblique, commencing at the upper part close against the cartilaginous covering of the head of the bone, and extending downward and outward, so as to terminate in a point at the lower surface of the neck, one inch from the cartilaginous covering of the head. The posterior surface of the shell of the neck had the appearance of having been splintered, so as to make a part of the fractured end of the pelvic portion extend in one situation a little on the outside of the capsular ligament, and where no union had taken place.

In a fourth instance, where the necks of both thigh-bones had been broken at different periods, the parts were examined after the patient's decease. On the right side, the fracture extended through the neck of the bone, in a direction downward and outward. In one part, a portion of the reflected membrane remained entire; but was separated from the neck of the bone in such a manner as not to prevent the retraction of the limb. The head of the bone was somewhat excavated; and that portion of the neck attached to the trochanter was partially absorbed. There was no soft substance between the surfaces of the fracture. A bond of union, however, consisting of fibrinous matter, adhered to the sides of the ends of the fracture, and, in one part, it was strong. No surgical attempt had been made to unite the fracture on the right side. On the left, the neck of the bone had been broken within the capsule, and was firmly united. The cervix was nearly absorbed; and the head was depressed, so as to come within about two lines of the trochanter minor, to which it was united at its base by a small short process of bone. Strong bands of ligament were seen connecting the pelvic portion of bone to the capsule, which had become thickened, and much smaller than natural. There had been a longitudinal fracture of the trochanter major, but quite independent of the injury of the cervix. The fracture of the latter part was united with the head, about two inches and a half below its natural situation; which leads Mr. Amesbury to believe, that what he terms the close coverings of the neck of the bone had been nearly or quite divided. A longitudinal section of the head and neck of the bone showed that the fracture had taken place close to the head. The uniting callus had become cancellated; but, he says, that the direction of the fracture could be seen "by the situation of the trochanteral portion of the neck, when examined in different parts of its circumference." (See *Amesbury on Fractures, &c.* p. 43, &c.)

These, and other cases and dissections, sufficiently establish the possibility of bony union in fractures entirely within the capsular ligament. But this is not the ordinary mode of union; and no doubt is now entertained about many preparations, exhibited as specimens of it, not being good and authentic ones. The rapidity, with which absorption proceeds in the head and neck of the thigh-bone after fractures, brings about such changes as must soon greatly obscure the exact original situation and direction of the injury, and particularly the question, whether the injury reached also to the outside of the capsular ligament. That fractures extending beyond the capsular ligament may be united by bone, is admitted by all parties, as well as the fact, that those entirely within the capsule are often united with the intervention of fibrous or ligamentous bands. In confirmation of this circumstance, I have already cited the dissections performed by Dr. Colles of Dublin; and, in further proof of it, I refer to the preparations in the museum of the College of Surgeons at Edinburgh, as specified by Mr. B. Bell of that city. (*On Diseases of the Bones*, p. 205, &c., 1828.)

Having spoken of the nature of fractures of the neck of the thigh-bone, within and without the capsular ligament, I come next to the consideration of the proper practice to be adopted. In the first description of the injury, as osseous union is rare, ought we to endeavour to keep the fragments as nearly in a state of apposition as possible, and subject the patient to rest and confinement, with the view of promoting the other modes of union, so well pointed out in Dr. Colles's paper? Or, should we, as Sir A. Cooper does, avoid confining the patient to any long, or continued extension, "as being likely to be productive of ill health, without the probability of producing union?" Yet, it appears both from this gentleman's own statements, and from those of Dr. Colles, Mr. Langstaff, Mr. B. Bell, and others, that though a bony union cannot always be effected, other connecting means may be established; and the more perfect these are, the less will be the subsequent lameness. So long, therefore, as these facts are incontrovertible, I should be disposed to recommend surgeons to do every thing in their power to keep the limb quiet, and in a desirable posture, for a due length of time. On this point, all surgeons must, on reflection, be unanimous. It is one that I have always insisted upon in my surgical writings, and it is one that is very properly defended by Mr. Amesbury. For this purpose, sometimes Desault's or Boyer's apparatus, with the limb in the straight posture; sometimes the double inclined plane, with the limb in the bent position, and the patient on his back; and sometimes, in America, Hagedorn's ingenious plan of using the sound limb, as the part to which the long splint, and footboard, with numerous perforations, should be attached, in order that the length of the injured limb, and the right position of it and the foot, may be effectually maintained; are preferred. Sir A. Cooper merely places one pillow under the whole length of the limb, and puts another transversely, under the patient's knee, so as to keep the limb in an easy bent position. In a fortnight, or three weeks, the patient is allowed to sit upon a high chair, and, in a few more days, he begins to take exercise upon crutches. After a time, these are laid aside, a stick substituted for them, and, in a few months, this assistance may be dispensed with. At the end of the treatment, a shoe must be worn with a sole of equal thickness to the diminished length of the limb. (*Surgical Essays*, part ii. p. 50.) On this plan, of course, no bony union can be expected, and, I prefer the doctrine of Dupuytren and Langstaff, that full time should be afforded for the chance of osseous union being completed, and efficient means adopted to keep the limb quiet and in the best position. From one hundred to one hundred and forty days are specified by Dupuytren as necessary for the consolidation of the callus. (*Clin. Chir.* t. ii. p. 99.)

In the treatment of such fractures of the neck of the femur as are situated on the outside of the capsular ligament, Sir A. Cooper prefers the position in which the patient lies on his back, with the injured limb in a bent posture, supported on what is termed the double inclined plane. When the limb has been placed over this machine, in an easy bent position, a long splint, reaching above the trochanter major, is applied to the outer side of the thigh, and fastened to the pelvis with a strong leathern strap, so as to press one portion of bone towards the other. The lower part of the splint is also fastened to the outside of the knee with a strap. The limb is to be kept as quiet as possible for eight weeks, at the end of which time the patient may leave his bed, if the attempt should not cause too much pain; but the splint is to be continued another fortnight. (*Surgical Essays*, part ii. p. 59.)

Dupuytren laid the patient on his back; bent the thigh on the pelvis, and the leg on the thigh. He then reduced the displaced outer fragment. He disapproved of continued and forcible extension; and preferred a double inclined plane, composed of several pillows rolled firmly up into the form of bolsters, placed one above the other, and secured together by stitching. Along this double plane he placed another pillow lengthwise, extending from the hip to the heel. The leg and thigh were retained in their places by sheets folded round the limb after the manner of a cravat, and fastened to the bedposts. When consolidation had taken place, the double inclined plane was gradually lowered.

In University College Hospital I have, in many cases, successfully employed the double inclined plane with a pelvis strap; but have latterly tried still more extensively the straight position and long splints with equal success, and, perhaps, more comfort to the patient.

Pott's method of treatment, with reference to these cases, is now entirely renounced. The bad effects and painful consequences of having the whole weight of the trunk operating upon the fractured ends of the bone, which are often not properly in contact, are too obvious to need any comment. Yet, this injudicious pressure was made in the position recommended by Pott, which also forbids the use of long effective splints, and all assistance from moderate continued extension.

A fracture of the neck of the thigh-bone may be complicated with a dislocation of the head of the bone. (See *J. G. Haase, De Fracturâ Colli Ossis Femoris, cum Luxatione Capitis ejusdem Ossis conjuncta*. Lips. 1798.)

For further information, the following authors may be consulted. *C. G. Ludwig*, de Collo Femoris ejusque Fractura Programma. Lips. 1755. *Bellocq*, in Mém. de l'Acad. de Chir. t. iii. *Aitken*'s and *Gooch*'s Machines are described in *B. Bell*'s Surgery, vol. iv. *Sabatier*, in Mém. de l'Acad. de Chir. t. iv. *Duverney*, Mal. des Os, t. i. *Unger*, in *Richter*'s Bibl. b. vi. p. 520. *Theden*, Neue Bemerkungen, &c. th. 2. *Brunninghausen*, über den Bruch des Schenkelbeinhalses, &c. Wurzb. 1789. *Van Gescher*, über die Entstellungen des Rückgrats, und über der Verrenkungen und Bruche des Schenkelbeins. aus d. Holland. *Hedenus*, in *Bernstein*'s Darstellung des Chir. Verbandes, tab. xlii. fig. 82. and 83. *M. Hagedorn*, über der Bruch des Schenkelbeinhalses, &c. Leipz. 1808. *J. N. Sauter*, Anweisung die Beinbrüche der Gliedmassen, vorzüglich die complicierten, und den Schenkelbeinhalsbruch nach einer neuen, &c. Methode, sicher zu heilen, 8vo. Konstanz. 1812. *J. Wilson*, on the Structure and Physiology of the Skeleton, &c. p. 243, &c. 8vo. Lond. 1820. *Dr. Colles*, in Dublin Hospital Reports, vol. ii. *Sir A. Cooper*, Surgical Essays, part ii.; and on Dislocations, &c. 4to. 1822, with Appendix, 1823. *H. Earle*, Practical Obs. on Surgery, 1823. *Boyer*, Mal. Chir. t. iii. *John Bell*, Principles of Surgery, 4to. 1801. p. 549, &c. *Sir C. Bell*, on Injuries of the Spine and Thigh-Bone, 4to. 1824. *Baron Larrey*, in Journ. Complém. t. viii. p. 116. *G. Langstaff*, Cases of Fractured Neck of the Thigh-Bone within the Capsular Ligament, with the Dissections and Obs. in Med. Chir. Trans. vol. xiii. *E. Stanley*, Cases of Injuries of the Hip-Joint, Op. et vol. cit. *G. J. Guthrie*, on the Diagnosis and on the Inversion of the Foot in Fracture of the Neck, &c. of the Thigh-Bone, vol. cit. p. 103. *John Howship*, Op. cit. vol. xix. *Syme*, in Edin. Med. Journ. April, 1826. *B. Bell*, on Diseases of the Bone, 1828. *J. Amesbury*, Obs. on Fractures of the Upper Third of the Thigh-Bone, &c. 2d ed. 1829. *R. W. Smith*, on the Diagnosis of Fractures of the Neck of the Femur; Dubl. Journ. of Med. Science, vol. vi. p. 205. *W. H. Porter*, Op. cit. vol. x. p. 243. *M. le Baron Dupuytren*, Leçons Orales de Clinique Chir. t. ii. art. 2. 8vo. Paris. 1832. *Herbert Mayo*, Outlines of Human Pathology, chap. *i.* 8vo. Lond. 1835.

Oblique Fractures of the external or internal Condyle of the Femur into the Joint.

In these cases, Sir A. Cooper prefers the straight position, because the tibia presses the extremity of the broken condyle into a line with that which i not injured. The limb is to be put in the extended posture upon a pillow, and evaporating lotions and leeches are to be used for the removal of the swelling and inflammation. "When this object has been effected, a roller is to be applied around the knee, and a piece of stiff pasteboard, about sixteen inches long, and sufficiently wide to extend entirely under the joint, and to pass on each side of it, so as to reach to the edge of the patella, is to be dipped in warm water, and applied under the knee, and confined by a roller. When this is dry, it has exactly adapted itself to the form of the joint, and this form it afterwards retains, so as best to confine the bones. Splints of wood or tin may be used on each side of the joint; but they are apt to make uneasy pressure. In five weeks, passive motion of the limb may be gently begun, to prevent anchylosis." (*Surgical Essays*, part ii. p. 101.; also *Treatise*, p. 221.) A compound fracture of the external condyle is recorded, a portion of which was, after a time, extracted, and the case ended so favourably, that the patient, who was a boy, was able to bend and extend the leg without pain.

For fractures, just above the condyles, Sir A. Cooper recommends the bent position, without which, he says, deformity is sure to follow. He advises the limb to be placed over the double inclined plane, and a roller applied round the lower portion of the femur. (p. 103.)

Fractures of the Patella

May be produced either by the action of external bodies, or by that of the extensor muscles. In the latter case, the fall is subsequent to the fracture, and, as Camper has remarked, it is mostly only an effect of it. For instance, the line of gravity of the body is, by some cause or another, inclined backward; the muscles in front contract to bring it forward again; the extensors act on the patella; this breaks, and the fall ensues. That it is the action of the muscles, and not the fall, which usually breaks the knee-pan, is well ascertained. Sometimes the fracture occurs, though the patient completely succeeds in preventing himself from falling backward, as we find exemplified in two cases reported by Sir A. Cooper. (*Surgical Essays*, part ii. p. 85.) A soldier broke the patella in endeavouring to kick his serjeant; the olecranon has been broken in throwing a stone. In the operating theatre of the Hôtel-Dieu, both the knee-pans of a patient were broken by the violent spasms of the muscles, which followed an operation for the stone. The force of the muscles occasionally ruptures the common tendon of the extensor muscles, or, what is more frequent, the ligament of the patella. Of these cases, Petit, Desault, and Sabatier, met with examples. When the patella is broken longitudinally, the cause is always outward violence. (*Œuvres Chir. de Desault*, t. i. p. 252.)

A transverse fracture of the patella may also originate from a blow, or fall, on the part; but, in all common cases, it is produced by the violent action of the extensor muscles of the leg. It is only of late years, however, that the true mode, in which the bone is usually broken, has been understood. For the production of a transverse fracture of the knee-pan, the extensor muscles of the leg need not act with a convulsive force, their ordinary action being strong enough to produce the effect in question, when the body is inclined backward, and the patient is in danger of falling upon his occiput. In this state, the thigh being bent, the extensor muscles of the leg contract powerfully, in order to bring the body forwards, and prevent the fall backwards; and the patella, whose posterior surface then rests only by a point against the fore part of the condyles of the femur, is placed between the resistance of the ligament binding it to the tibia, and the action of the extensor muscles. A fracture now happens the more easily, because, by the flexion of the knee, the line of the extensor muscles, and that of the ligament of the patella, are rendered oblique, with respect to the vertical axis of this bone, which is bent backwards at the point where it rests upon the condyles. (See *Boyer, Mal. Chir.* t. iii. p. 322.; *C. Bell's Operative Surgery*, vol. ii. p. 201, 8vo. Lond. 1809; *A. Cooper's Surgical Essays*, part ii. p. 86.) By violent spasmodic action of the extensor muscles, however, the patella may be broken transversely, while the limb is perfectly straight. A very singular case is mentioned by Sir A. Cooper, where a patella, which had been formerly broken, and united by ligament, was again divided into two portions, in consequence of the destruction of the uniting medium by ulceration. (Vol. cit. p. 100.) A case is also on record, where the ligamentous uniting substance was so incorporated with the skin, that, when the latter happened to be lacerated, the knee-joint was laid open, and amputation became necessary. (*C. Bell, Op. Surgery*, vol. ii. p. 204.)

In transverse fractures, there is a considerable separation between the two fragments of the bone, very perceptible to the finger, when the hand is placed on the knee. This separation is not occasioned equally by both portions; the upper one, embraced by the extensor muscles, is drawn upward very forcibly by them, the patella no longer resisting, while the inferior portion, being merely connected with the ligament below, is not moved by any muscle, and can only be displaced by the motions of the leg, to which it is attached. Hence, the separation is least when the limb is extended, being then only produced by the upper fragment; greatest, when the limb is bent, because both pieces contribute to it; and it may be increased or diminished, by bending the knee more or less.

As Boyer has particularly noticed, the laceration, or not, of the tendinous expansion, upon the front of the patella, makes a material difference in these cases, because it is a part of great importance in the cure. According to this author, a portion of it in simple fractures of the patella, generally escapes laceration, and the separation of the fragments is then not very considerable; but the violent action of the extensor muscles, a fall subsequent to the fracture, or the bending of the knee too much, may separate the pieces of bone far from each other, and rupture the tendinous expansion. (*Mal. Chir.* t. iii. p. 328.) According to Sir A. Cooper, "when the ligament is but little torn, the separation will be but half an inch; but under great extent of injury, the bone is drawn five inches upwards, the capsular ligament, and tendinous aponeurosis covering it, being then greatly lacerated." (*Surgical Essays*, part ii. p. 84.)

The upper portion of bone may be moved transversely, and pain is thus excited, but no crepitus can be felt, as the two pieces of bone are not sufficiently near each other. When the swelling of the knee, consequent to fractures of the patella, is great, the symptoms of the injury may be more or less obscure. However, in consequence of the inability of the extensor muscles to move the leg, except in a few cases where the fracture is very low, the patient cannot stand without difficulty, and is unable to walk.

In the treatment, the chief indications are to overcome the action of the extensor muscles of the leg, and to keep the fragments as near each other as possible, partly by a judicious position of the limb, and partly by mechanical means. The first indication is fulfilled by relaxing the above-mentioned muscles; 1st, by extending the leg; 2dly, by bending the thigh on the pelvis, or, in other words, raising the femur, so that the distance between the knee and anterior inferior spinous process of the ilium, and brim of the acetabulum, may be as little as possible; which object, however, will also require the body to be raised, and the pelvis somewhat inclined forwards, so that the rectus may be perfectly relaxed. In short, as Richter long ago advised, the patient should be almost in a sitting posture, the trunk forming a right angle with the thigh. (*Bibl. Chir.* b. vi. p. 611. Göttingen, 1782.) 3dly, the muscles are to be compressed with a roller. The second indication, or that of placing and maintaining the fragments in contact, or as nearly so as circumstances will allow, is in a great measure already answered by the above-recommended position of the limb, and trunk; but it is not perfectly fulfilled, unless the upper portion of the bone be also pressed towards the lower fragment, and mechanically held in this situation by the pressure of an apparatus, or bandage. And, in pushing the upper fragment towards the lower one, the surgeon should always be careful, that the skin be not depressed and pinched between them.

After putting the patient to bed upon a mattress, and in the desirable posture, with the limb confined, supported, and raised, as above directed, upon a well-padded hollow splint, Sir A. Cooper applies at first no bandage to the knee, but covers it with linen wet with a lotion, composed of liq. plumbi acet. dilut. ℥v. and spir. vin. ℥j. If, on the succeeding day, or two, there be much tension, or ecchymosis, leeches should be applied, and the lotion continued; but the employment of a bandage is not to commence until the tension has subsided; for Sir A. Cooper assures us, that he has seen the greatest suffering, and such swelling as threatened gangrene, produced in these cases by the too early use of a roller. Instead of a circular bandage, placed above and below the broken bone, and drawn together with tape, &c. so as to bring the upper fragment towards the lower one, this experienced surgeon prefers the following method.—A leathern strap is buckled round the thigh, above the broken and elevated portion of bone, and from this circular piece of leather, another strap passes under the middle of the foot, the leg being extended, and the foot considerably raised. This strap is brought up to each side of the patella, and buckled to the leathern band already applied to the lower part of the thigh. It may also be fastened to the foot, or any part of the leg, with tapes. The limb is to be confined in this position five weeks, if the patient be an adult, and six if advanced in years. Then a slight passive motion is to be begun, and to be gently increased, from day to day, until the flexion of the knee is complete. (*Surgical Essays*, part ii. p. 91.) But, although the impropriety of making any constriction of the knee with a bandage, while the skin is swelled and inflamed, must be obvious, the surgeon ought to be apprised, that such swelling and inflammation ought not to occasion the least delay in placing the limb in the right posture, and pressing the upper fragment towards the lower one. Mohrenheim ascribes the lameness formerly so frequent after this fracture, partly to the custom of not thinking of bringing the pieces of bone together until the swelling had subsided, and partly to the fashion of bending the joint too soon, with the view of preserving its motion. But, says he, nothing can be clearer, than that it is most advantageous to attend to the union of the fracture first, and to the flexibility of the joint afterwards. (*Beobachtungen*, b. ii. 8vo. 1783.) Boyer has likewise remarked, that the uniting substance is apt to yield, and become lengthened, by bending the knee too early, and he therefore never allows this motion to be performed before the end of two months. When the ligamentous substance is long, and the patient very slow in regaining the use of the extensor muscles, he should sit every day on a table, and endeavour to bring them into action; and as this increases, a weight may be affixed to the foot, as Hunter, Sheldon, &c. recommend.

Nothing keeps the leg more surely extended, than a long, broad, excavated splint, with a suitable pad, applied to the posterior part of the thigh and leg, and fixed there with a roller, while the thigh itself is to be bent by raising the whole limb, from the heel to the top of the thigh, with pillows, which, of course, must form a gradual ascent from the tuberosity of the ischium to the foot.

The broken patella commonly unites by means of a ligamentous substance, instead of bone. However, that an osseous union may follow a transverse fracture of the patella, and still more frequently a perpendicular one, is a fact of which there is not now the slightest doubt. Thus, Lallement has published an unequivocal specimen of a transverse fracture united by bone, with the history of the case, and the appearances after the death of the patient from some other affection. (*Boyer, Mal. Chir.* t. iii. p. 355, &c.) In the collection of Dr. William Hunter, there is one well marked instance of the bony union of a transverse fracture of the patella, and other examples have been seen in the dead subject by Mr. Wilson. (*On the Structure, Physiology, &c. of the Skeleton*, p. 240.) In Sir Charles Bell's museum were likewise similar specimens, one or two of which are now in the museum of University College. (*On Injuries of the Spine and Thigh-Bone*, p. 57, 58.) The reason why transverse fractures of the patella do not commonly unite by callus, is not owing to the want of power in this bone to produce an osseous connecting substance; for, as Larrey has several times noticed, if the fragments are kept in perfect contact by means of a suitable apparatus, their bony reunion becomes so complete, that scarcely any vestige of the injury can afterwards be traced. (*Journ. Complém.* t. viii. p. 114.) Indeed, it is a fact, on which Larrey dwells, as affording a proof that callus is produced not by the periosteum, but by the vessels of the bones themselves. And, what must add strength to the purport of the foregoing remarks, is the consideration, that perpendicular or longitudinal fractures of the patella, which are not liable to any displacement from the action of the extensor muscles of the leg, readily admit of bony union. (*Wilson on the Structure and Physiology, &c. of the Skeleton*, p. 239.) This is a statement which, I think, could not be rendered doubtful by any experiments made on animals, without the advantages of quietude and proper treatment. Yet, there are other facts related, which prove that, both in longitudinal and transverse fractures, a ligamentous union is generally produced, when the fragments are separated; but, if these are not drawn asunder, an osseous union takes place. Thus, in one case, reported by Sir A. Cooper, one third of the patella was separated from the rest of this bone, and had united by ligament, a free motion being left between the fragments. (*Surgical Essays*, part ii. p. 94.) The same gentleman divided the patella longitudinally in a dog, without extending the division into the tendon above, or the ligament below, so that the fragments could not be separated. In three weeks, a close bony union was the result. (p. 95.) A case is also related, in which a gentleman fractured the patella transversely, and the lower portion likewise perpendicularly. The transverse fracture united as usual, by ligament; the perpendicular one, by bone. (p. 96.) Sir Charles Bell gives another explanation of the cause of union being by bone or ligament. In the common case, says he, of fracture of the patella by the sudden action of the quadriceps extensor, the pieces are separated without that degree of violence which is necessary to produce reunion by bone. But, when the patella is broken by a blow, or kick, there is not only less retraction, but "the injury, bloody effusion, tumefaction, and rigidity of the parts, resemble that which attends the fracture of any other bone, and the fragments unite by bone." (*On Injuries of the Spine, &c.* p. 58.)

The incorrect notions, formerly entertained, respecting the inconveniences of an exudation and projection of the callus into the joint after a fracture of the patella, and especially when the fragments are kept in contact, were long ago refuted by Pott and Sheldon. (*Pott's Chir. Works*, vol. i. p. 332. ed. of 1808. *Sheldon's Essay on the Fracture of the Patella, &c.* 8vo. Lond. 1789.) On the contrary, as Sir A. Cooper particularly remarks, "the internal articular surface of the bone preserves its natural smoothness." (*Essays*, part ii. p. 86.) How such doctrine of a superabundant callus could be reconciled with the doubts about a bony union being ever possible, appears difficult of explanation.

Pott, and some others, thought that an interspace between the two pieces of the patella, with a certain length of the connecting substance, might be advantageous in the motion of the joint; but Desault, Boyer, Sir A. Cooper, Sir J. Earle, and others, have always found, that the greater the distance between the two pieces of the bone, the greater is the difficulty afterwards in walking up a rising, or over an unequal ground.

In the treatment of a longitudinal, or perpendicular fracture of the patella, the leg should be kept extended, leeches used, and a cold lotion applied. After a few days a roller is to be put round the limb, and then a laced knee-cap, with straps buckled round the limb above and below the patella. (*Sir A. Cooper*, vol. cit. p. 96.) The experience of Dupuytren confirms the fact, that a longitudinal fracture of the patella is soon firmly consolidated. (*Annuaire Méd. Chir. de Paris*, p. 94. 4to. Paris, 1819.) Compound fractures of the patella frequently terminate in the death of the patient, unless amputation be performed early. The injury, however, does not invariably lead either to the loss of life or limb. I saw a case in St. Bartholomew's Hospital, in the year 1820, under Mr. Vincent, where the patella was broken to pieces, and the opening so extensive, that the fingers readily passed into the joint; yet, after a tedious confinement, the formation of abscesses, and the separation of several fragments of bone, the patient recovered with a stiff joint. In general, however, I believe, with Sir A. Cooper, that in compound fractures of the patella, if the laceration be extensive, or the contusion very considerable, amputation will be required: but, if the wound be small, the patient not irritable, and no sloughing of the integuments, or ligament, likely to occur, it will be best to try to save the limb. (Vol. cit. p. 99.) The wound should be reunited as speedily as possible, and advantage taken of evaporating lotions, perfect rest in a desirable posture, a very low regimen, leeches, venesection, and saline opening medicines. Since the above remarks were first drawn up, I saw another case of bad compound fracture of the patella in St. Bartholomew's Hospital, where it had been about a month. No fragments of bone had then been removed, but a good deal of matter issued daily from the wound, and the patient was in considerable danger of losing his limb, or even his life.

In addition to the works already cited, consult *D. H. Meibomius*, de Patellæ Osse, ejusque Læsionibus, et Curatione. Franck. 1697. *P. Camper*, Diss. de Fracturâ Patellæ, et Olecrani, 4to. Hagæ Comit. 1789. *Buirer*, in v. Siebold, Chiron, 3. l. p. 64. *T. Alcock*, in Trans. of the Associated Apothecaries, &c. vol. i.

Fractures of the Leg

May be transverse or oblique. The first case is most common in children and in adults, who meet with fracture of the tibia above the lower fourth of the bone. (See *Sanson, in Dict. de Méd. et de Chir. Pratiques*, t. viii. p. 557.) Experience proves, that the bones of the leg are much more frequently broken together, than singly; a fact ascribed by Boyer to the strength of the knee and ankle-joints. (*Mal. Chir.* t. iii. p. 360.) The direction of an oblique fracture of the tibia is often from below upward, and from within outward, the end of the upper fragment mostly presenting itself under the skin at the front and inner part of the leg. In these cases, the longitudinal displacement of the fracture is less constant, than the horizontal and angular. However, when it does happen, the inferior fragments are drawn outward and backward, whilst the superior project internally and forward. The angular displacement may be produced either by the action of the posterior muscles of the leg, or the weight of the foot, and, in both cases, the angle projects forwards. But it may be directed posteriorly, if the heel be too much raised. A rotatory displacement, most commonly happening in the direction outwards, is produced by the inclination of the foot; but, if this be turned too much inwards, the rotatory displacement will be in that direction. A longitudinal displacement cannot so easily take place in transverse fractures, on account of the considerable extent of the surfaces of bone; but, in oblique fractures, the inferior fragments are almost always drawn upward by the action of the posterior muscles of the leg, in which position of the parts the lower ends of the superior fragments project forwards, and may be felt by the hand. Sometimes, however, when the solution of continuity is obliquely downward and outward, the anterior projection will be produced by the lower pieces. In both kinds of displacement, the pointed ends of the bones may tear and penetrate the integuments, and cause a compound fracture.

The usual symptoms, denoting a fracture of both bones of the leg, are a change in the direction and shape of the limb, pain, and incapability of walking, or bearing upon the limb, mobility of the fractured pieces, and a distinct crepitus.

Fractures near the knee are not very subject to displacement, on account of the thickness of the tibia at that part; but they are more dangerous than those of the middle of the bone, because often followed by inflammation of the knee-joint. Fractures, close to the ankle, are also severe accidents. Oblique fractures are more difficult of management than transverse, and, when the displacement is considerable, the integuments are in danger of being torn by the projecting points of the superior portion of the tibia.

To bad compound fractures of the leg most of the observations, already delivered on compound fractures in general, are applicable.

When the size of the tibia is compared with that of the fibula, and the close connection of these bones to each other is remembered, an opinion might be formed, that the first could never be broken without the second. Experience, however, proves the contrary; and reasons for this fact may be deduced from the consideration, that the tibia is the bone which supports the weight of the body, and that it is situated at the fore part of the limb, simply covered by the skin, and much exposed to the effects of direct violence. (See *Boyer, Mal. Chir.* t. iii. p. 373.) The fibula is, as it were, out of the line in which the weight of the body is transmitted to the foot. Its elasticity, which continues until old age; the few efforts sustained by it in the greater part of its length; the manner in which it is protected in front by the muscles in the interosseous space, and by the tibia itself; behind, by the muscles of the calf; and externally by the peronæi; are all circumstances tending to weaken the effect of external violence upon it, and to lessen the number of its fractures. Yet, Dupuytren calculated, that they were more frequent, than usually stated, and that those of the lower end of it, in relation to other fractures of the leg, were as one to three. (See *Clin. Chir.* t. i. p. 189.) Fractures at any point of the three upper thirds of the tibia can scarcely happen, except from direct violence, as that from a gunshot wound, a blow, or the passage of a heavy body over the leg. But the lower fourth is exposed both to the action of direct causes, and to fractures by *contre-coup*, as they are termed, like those which happen from a fall on the sole of the foot from a considerable height. Fractures of the lower end of the tibia alone are not common; the fibula being almost always broken at the same time. (*Sanson*, *Dict. de Méd. et de Chir. Pratiques*, t. viii. p. 557.) When the tibia alone is broken, the fracture is frequently transverse. When the injury happens near the knee, the great extent of the fractured surfaces prevents any considerable displacement of the fragments; and the fibula, acting as a support on the external side, contributes also to this effect. Boyer, however, saw one instance, in which the tibia had been broken by the kick of a horse, and the fragments displaced in the direction of the axis of the bone, which displacement could not be rectified, and the bone remained permanently arched.

The absence of displacement sometimes obscures the diagnosis of fractures of the tibia, and the difficulty is further increased by the little pain and inconvenience occasionally attending such a fracture, with which the patient has been known even to walk.

Whenever there is reason to suspect the accident, in consequence of a blow or a fall on the leg, the part should be minutely examined. The fingers are to be moved along the anterior surface and sharp edge of the tibia, the slightest inequality in which may be easily perceived, on account of their being covered only by the skin; and the motion of the pieces may be distinguished, by grasping the opposite ends of the bone, and pushing them in contrary directions. However, this motion, and the crepitus, are not always very plain, on account of the fibula not allowing the fractured portions to be sufficiently moved on one another.

In a review of the position and strength of the two bones of the leg, it will appear, that the tibia supports alone the whole weight of the body, every shock directed in the axis of the limb, and many kinds of force applied also in the transverse direction, without operating upon any particular point. Hence, the frequency of fractures of the tibia; and, if the fibula is generally broken likewise, the latter injury is subsequent to the other, and takes place because this slender bone is not capable of bearing the weight of the body, the impulse of external violence, and even the action of the muscles, after the tibia has given way. (*Dupuytren*, *Annuaire Méd. Chir. des Hôpitaux de Paris*, p. 15. 4to. Paris, 1819.) On the other hand, as the same distinguished surgeon remarks, the fibula being principally designed as a support for the outside of the foot, it is particularly when this function is to be executed and its lower end has to make resistance to efforts made in that direction, that it is fractured; and, if the lower part of the tibia be also sometimes broken by the same force, it is almost always consecutively, and not by the effect of a direct and simultaneous action upon the two bones. (p. 17.) All fractures of the fibula, however, are not caused in the preceding manner; and Dupuytren concurs with Boyer, Sir C. Bell, and all the best writers on this subject, in dividing these cases into two kinds: First, those in which the force is applied directly to the bone itself; Secondly, the more important and serious cases, in which the force operates upon the fibula, through the medium of the foot. With respect to the first class of cases, the situation of the fibula on the outer side of the leg, a situation which would seem to expose it much to external violence; its slenderness; the interspace left between it and the tibia, at the middle part of the leg; and the way in which each end of it rests upon the latter bone; would lead one to expect that its middle portion must often be broken; yet the case is less frequent than might be apprehended. And, as Dupuytren observes, there are two reasons for this fact; viz. the protection which the fibula receives from the peronæi muscles, and the rarity of circumstances capable of producing a fracture by a direct cause. These fractures, which are not usually attended with deformity, and, in some cases, even do not hinder the patient from bearing upon the foot, cannot for the most part be ascertained, unless attention be paid to the manner in which the accident was produced, and to the presence of ecchymosis, and of more or less pain in the part which has been struck or pressed upon; together with a degree of irregularity of the fibula, perceptible by the fingers, and a more or less distinct moveableness and crepitus of the ends of the fracture.

The usual causes of this sort of fracture are blows on the fibula, gunshot wounds, the fall of heavy bodies on the outside of the leg, or the passage of them over the same part. The foot is generally twisted, either inwards or outwards, and, in most instances, the accident is easily cured by means of rest, without being accompanied by any of the symptoms so often complicating other fractures of the fibula, produced by distortion of the foot. (*Dupuytren*, vol. cit. p. 40.) A striking analogy may be remarked between fractures of the central part of the fibula, and those of the corresponding portion of the ulna, and this in respect to causes, symptoms, treatment, and consequences. Fractures of the middle of the ulna, like those of the body of the fibula, are always occasioned by blows or falls on the fractured part, or by violence applied directly to the bone. Such fractures are scarcely ever attended with any deformity in the limb, incapacity of moving it, or displacement of the fragments; and just as some individuals are able to walk with a broken fibula, others, notwithstanding a fracture of the ulna, are found capable of using their fore-arm, nearly as well as if it were free from injury. The latter case, like that of a fracture of the fibula, can only be known by the recollection of the way in which the hurt was received, the pain, ecchymosis, irregularities, motion, and crepitus, which last effects are also not very obvious so high up the bone. Like fractures of the body of the fibula, those of the body of the ulna only require rest and discutient applications, and very seldom the bandages, &c. necessary in the treatment of fractures of both bones of the fore-arm, or of the radius alone. (Vol. cit. p. 50.)

Fractures of the fibula from an *indirect* cause may happen from the foot being violently twisted either inwards or outwards. In both instances, the cause of the fracture is a change in the direction of the line, in which the weight of the body is transmitted. In the first case, the said line, instead of following, as it commonly does, the axis of the tibia, and falling upon the astragalus, crosses the lower end of the tibia and the ankle-joint, obliquely from within outwards, and after passing across the malleolus externus, extends to the outside of the member. The parts then supporting the weight of the body are the malleolus externus, and the lower end of the tibia; besides which state of parts, the same malleolus is subjected to the traction of the external lateral ligaments, which operate with great force, in consequence of those ligaments being now nearly at a right angle with the lower end of the fibula, while this process itself is in contact with the astragalus, which is propelled from within outwards by the tibia. The latter bone, being thicker and stronger than the fibula, generally resists, and, if the malleolus internus sometimes happens to break, it is secondarily, as an effect of the displacement of the foot outwards.

In the other example, where the foot is twisted outwards, the centre of gravity of the body, instead of following its usual course, obliquely crosses the lower end of the fibula, the ankle-joint, and the malleolus internus, and falls on the ground at a greater or lesser distance from the inner edge of the foot. On the one side, the internal lateral ligaments and malleolus, and on the other, the lower end of the fibula, are then the parts which have to bear the weight of the whole body, and the force of the muscles; and they are also the parts which are torn and fractured; first, the internal lateral ligaments, or the malleolus; and, secondly, the lower portion of the fibula. (*Annuaire Méd. Chir. de Paris*, 1819. p. 66, 67.) Some of the symptoms of a fracture of the fibula, from an *indirect* cause, depend upon the fracture of that bone, and others upon the dislocation of the foot. They are divided by Dupuytren into two kinds; viz. *presumptive*, and *characteristic*. The first are, the way in which the patient received his hurt; a noise, or sort of crack heard by him at the instant of the injury; a fixed pain at the lower part of the fibula; a difficulty, or inability of walking; more or less swelling round the ankle, especially about the malleolus externus, and lower portion of the fibula. The *characteristic symptoms* are, an irregularity and unnatural moveableness of some point of the lower end of the fibula; a crepitus, which can be more or less distinctly felt by pressing upon and moving the part; mobility of the whole foot transversely, or horizontally; a facility of bringing the lower end of the fibula towards the tibia by pressure; a change in the point of incidence of the axis of the limb upon the foot; distortion of the foot outwards, and sometimes backwards; rotation of the same part upon its axis from within outwards; an angular depression, more or less manifest, at the outer and lower part of the leg; projection of the internal malleolus; disappearance of almost all these symptoms, as soon as reduction is effected by a force applied to the foot; and their immediate recurrence when such force is discontinued, particularly if the limb be in the extended posture. (Vol. cit. p. 68.)

In considering the varieties of simple fracture of the fibula, the first, to which Dupuytren adverts, is that in which the bone is broken *more than three inches above the extremity of the malleolus externus; a case, neither accompanied nor followed by any displacement of the foot*, and almost always produced by the direct application of violence to the broken part of the bone.

A second variety of simple fractures of the fibula is when the bone has been broken, either by direct, or indirect force, within three inches from the end of the malleolus externus, and when the foot is not displaced, though much displacement is possible, and, indeed, often arises from the slightest effort, or movement, made by the patient. The most frequent point of injury is about two inches and a half above the extremity of the outer malleolus. This is generally the place of a fracture, caused by a twist of the foot outwards; but, the accident may happen lower down, as is commonly seen, when the fracture is occasioned by a twist of the foot inwards.

These fractures of the fibula, abstractedly viewed, are not of much importance in themselves; but with reference to the manner in which they facilitate the dislocation of the foot, they are very serious.

Amongst the most frequent complications of fractures of the fibula, are the rupture of the internal lateral ligaments, the detachment of the point of the inner malleolus, and fracture of the lower part of the tibia. When these injuries originate from a violent twist of the foot outwards, they precede the fracture of the fibula; but, when they are caused by a twist inwards, they follow the breaking of that bone. (*Dupuytren*, vol. cit. p. 96.)

Besides distortion of the foot outwards, or inwards, as attending certain fractures of the fibula, another complication may be dislocation of the foot backwards, produced by the action of the muscles of the calf, and not by the same causes which broke the bone. However, whenever the malleolus internus has not given way, the dislocation is incomplete, and the foot is inclined outwards as well as backwards. In the complete luxation, Dupuytren considers the bent posture exceedingly advantageous, though he admits that it will not always maintain the reduction.

Treatment of Fractures of the Leg.

As in cases of fractured thighs, the practitioner may adopt either a bent or a straight position of the limb: in this country, surgeons mostly follow Pott's advice, and select the first one. A few, however, are advocates for the extended position, and amongst them, Dr. Houston deserves to be particularly noticed, on account of the ingenuity of his arguments, the novelty of his views respecting the causes of spasmodic action of the muscles in these cases, and the facts which he brings forward. (See *Dublin Journ. of Med. Science*, vol. viii.) But, notwithstanding his objections, to the bent position, experience has taught me, that it is, generally speaking, the most advantageous for a broken leg. The strong muscles of the calf, are the powers which tend to displace the ends of the fracture, and their relaxation is a thing of the first-rate importance. It is quite different in the thigh, where the muscles are so numerous, that the attempt to relax, by any position of the limb, all such as have the power of displacing the fragments, would be in vain. I am ready to acknowledge, however, that, in Pott's method, the apparatus is defective, inasmuch as it does not keep the knee-joint from moving; yet it is certain, that such motion has not so injurious an effect upon fractures of the leg, as it has upon those of the thigh. When the case is complicated with a wound, which cannot be dressed in the bent posture of the limb without great disturbance of the fracture, the straight position ought unquestionably to be preferred. With respect to one of Pott's objections to this position, viz. that it makes the knee stiff for a long while afterwards, I suspect that we should not lay much stress upon the circumstance; because, as Boyer has correctly observed, it is always the joint situated below the fracture that is thus affected.

In the fracture of both tibia and fibula (says Pott), the knee should be moderately bent; the thigh, body, and leg, being in the same position as in the broken thigh. If common splints be used, one should be placed underneath the leg, extending from above the knee to below the ankle, the foot being properly supported by pillows, bolsters, &c.; and another splint of the same length should be placed on the upper side, comprehending both joints in the same manner.

The strong muscles of the leg being relaxed, the surgeon is to make such extension as seems requisite, for bringing the ends of the fracture into even apposition. Then he is carefully to raise the leg a little way from the surface of the bed, by taking firm hold of the limb, above and below the fracture, and elevating the broken bones together, in such a way as shall keep both the upper and lower portions as nearly as possible on the same level. At this moment an assistant should put exactly beneath the leg the under splint, which has been previously made ready, by covering it with a soft pad, and laying over this an eighteen-tailed bandage. The limb is now to be gently depressed, till it rests on the apparatus. The surgeon, before proceeding further, must once more observe that the ends of the bones are evenly in contact. Being assured of this important point, he is to apply a piece of soap-plaster, and lay down the tails of the bandage. Another soft pad, well-filled with tow, is next to be put over the upper surface of the leg, and over that the other splint, and then the straps are to be fastened.

This mode of treatment, as preferred by Pott and his followers, is less extensively adopted at the present time, than formerly. The disadvantage of leaving the limb, and especially the knee, moveable, must be self-evident; and whoever has had the opportunity of observing the treatment of fractures of the leg in a slightly flexed position, on M'Intyre's double inclined plane, with the patient on his back, must be fully convinced of its superiority, and greater simplicity. No eighteen-tailed bandage is required. The whole limb, including knee and foot, is kept perfectly steady. A circular hole, as advised by Mr. Liston, is made in the apparatus unper the heel, so as to lessen the pressure in that situation, and the chance of ulceration, or sloughing. The apparatus, lined by proper pads, receives the limb; the foot is supported upon the foot-piece, with the intervention of soft materials; and the limb, from the lower part of the thigh down to the toes, is then encircled, together with the double inclined plane and its foot-piece, with common rollers. Of these, we generally employ three: one for the thigh, knee, and upper part of the leg; a second, for the foot, and the leg; and a third, for the central part of the leg, and place of the fracture, which is put on last. One great advantage of this method is, that the central piece of the roller may be removed as often as the surgeon pleases, and the fracture examined, or, if a compound one, the wound cleaned and dressed, without the slightest disturbance of the fracture itself, or any motion of the limb.

Pott's method of treating fractures of the fibula, complicated with luxation of the tibia, is described in the article Dislocations. I consider it a very inferior plan, to that followed in University College Hospital with M'Intyre's apparatus. I would make the same observation with respect to Dupuytren's mode, ingenious and scientific as it is. Pott's method of treatment is not calculated to prevent the falling-in of the lower extremity of the fibula towards the tibia. In a fracture of the lower end of the fibula, when the foot is brought into the state of extreme adduction, it draws by means of the lateral ligaments the point of the outer malleolus in an inward direction, and, consequently, the fractured portion corresponding to it is drawn outwards from the tibia. It is on this principle, that Dupuytren's mode of treating this accident is founded. In all cases, then, a fracture of the fibula, accompanied with luxation of the astragalus inwards, (that is, with distortion of the foot outwards,) requires an apparatus, which maintains the foot turned inwards, and the inferior fragment of the fibula raised from the tibia, and in the direction of the superior fragment. The simple apparatus recommended by Dupuytren is as follows: a cushion, a splint, and two bandages are the whole of it. The cushion, made of linen, and stuffed two thirds full of hair-balls, or chaff enclosed in bags in the usual manner, should be two feet and a half in length, four or five inches in breadth, and three or four inches in thickness. The splint is to be from twenty to twenty-three inches in length, and three inches broad. Lastly, the two rollers should each be from four to five yards in length. The cushion, doubled in the form of a wedge, should be applied on the internal side of the fractured limb, its base below, and resting on the internal malleolus, without passing beyond it; its summit above on the internal condyle of the femur. The limb is thus protected from the splint, which derives from the pad a support, that keeps it at the distance of several inches from the internal margin of the foot, and at the same time tends to throw the tibia outward. The splint, applied along the cushion, should extend six or seven inches below it, which will be about four inches below the internal margin of the foot. These parts of the apparatus being thus disposed, should then be fixed by one of the bandages passed round the limb below the knee, when the portion of the splint extending below the cushion will leave between itself and the foot an interval of several inches, and furnish a *point d'appui* to which the foot may be drawn from without inwards. In order to affect this purpose, the second bandage should be drawn from this point over the instep and heel, alternately embracing the splint and the parts of the limb just indicated, in circles gradually lessening, and forming the figure of the cypher 8 with the crossing part on the splint. Thus, the apparatus acts on the principle of a lever of the *first kind*, in which the *point d'appui* is the base of the cushion, a little above the malleolus internus, and in which the resistance, as well as the power acting on the fracture, are in the extremities of the foot. The foot thus drawn must yield to the action of the lower bandage, while the tibia, pressed by the base of the cushion, must be propelled outwards with the astragalus. Lastly, it is evident, that as the lower fragment of the fibula is drawn downwards by the external lateral ligaments of the ankle, a tilting movement must be produced on the external surface of the astragalus, contrary to that which displaced it. With the view of obtaining a complete reduction, Dupuytren says, that the surgeon must not confine himself to drawing the foot in a perpendicular line under the limb; it must be brought as much inwards, as it had been turned outwards by the peroneal muscles.

After the foot has been retained a good while in this forced state of adduction, if it should not return to its ordinary position, the defect may be easily remedied by applying the preceding apparatus to the outer surface of the leg and foot.

When, with a fracture of the fibula, the foot is drawn backwards and upwards, Dupuytren applies the splint and cushion to the back part of the leg down to the heel. One roller is applied below the knee; and a second round the lower end of the tibia and splint. A square pad should always be put between the lower bandage and the tibia. Of 207 cases of fracture of the fibula, comprising all the varieties of this accident treated in the above way, by Dupuytren, 202 were cured; the remaining five died, three of them from the consequences of the injury itself, or from complications independent of it.

Seven tenths of them happened to the right leg; six tenths arose from violent adductive motions of the foot; three tenths from similar abductive movements; and one tenth from blows, or the passage of some heavy body over the external and inferior part of the limb. With respect to the seat of the fracture of the fibula; in five tenths it was two inches from the lowermost point of the external malleolus; in three tenths, below this point; and in two above it. Cases, within two inches of the external malleolus, were often complicated with displacement of the foot; the others but rarely. (See *Dupuytren*, in *Annuaire Méd. Chir. des Hôpitaux de Paris*, 4to. Paris, 1819.; also, in *Leçons Orales de Clin. Chir.* t. i. art. 10. p. 189.)

Although fractures of the middle and upper parts of the fibula are often overlooked, and neglected, there is no displacement, and no ill consequences ensue; but things are different with regard to fractures of the lower end of the bone. In an example of fracture of the lower end of the fibula, that was mistaken for a sprain, the patient was permitted to walk about before an union had taken place. The consequences were a distortion of the foot, and a tendency to a dislocation of it inwards, followed by such severe symptoms as nearly led to amputation. After a confinement of eight months, the limb was saved; but the ankle continued stiff, and of course the patient was yet a cripple. (See *J. Cloquet, Pathologie Chir.* p. 45.) Some interesting particulars of the dissection of a case of dislocation of the ankle, and fracture of the fibula, which had been neglected for three or four weeks, the limb being in continued exertion all this time, were published by Mr. Lawrence. (See *Med. Chir. Trans.* vol. xvii. p. 58.) The patient was a lunatic, who died about nine months after the accident in a state of most furious mania. The tibia had partially lost its bearing on the astragalus. The outer half only of its inferior articular surface rested on the latter bone. The inner portion, with the malleolus internus, formed an unnatural prominence on the inside of the ankle. The fibula had been broken just above the external malleolus, and the fracture had been consolidated by a large formation of bony matter, which had made the lower extremity of the bone nearly equal in size to that of the tibia, and had anchylosed it to the latter. Amongst other changes, the superior convex surface of the astragalus had become partially flattened; and the cartilaginous covering was rubbed off it on the outside, where the broken end of the fibula had come in contact with it. The internal lateral ligament was greatly thickened, and formed a hard fibro-cartilaginous mass, in which some bony matter was deposited. Its attachment to the tibia was nearly as thick as the end of the thumb, and extended to that part of the inferior surface of the bone, which projected over the inner edge of the astragalus. The ligaments, connecting the external malleolus to the foot, were unaltered. The anterior articular convexity of the astragalus was partly raised out of the cavity of the navicular bone, apparently from the former bone having been subjected to unusual pressure on the back and outer part of its upper surface, in consequence of the altered bearing of the leg.

In an oblique fracture of the head of the tibia, extending into the knee-joint, Sir A. Cooper recommends the straight position, in which the femur has the good effect of keeping the articular surfaces of the tibia even. A roller is to be used for pressing one fragment towards the other; a pasteboard splint is also to be applied with the same view; and early passive motion of the joint is to be practised, in order to prevent anchylosis. When the fracture is oblique, but does not reach into the joint, he prefers placing the limb on the double inclined plane. (*Surgical Essays*, part i. p. 103.; and *On Dislocations*, &c. p. 235.)

Fractures of the Scapula.

Fractures of the body of the scapula are not common; a circumstance explicable by its deep and covered position, and its great mobility. Nor could such an accident arise without considerable direct violence. However, some parts of the scapula being more superficial, and of a form more likely to be acted upon by external bodies, are more frequently fractured: such are the acromion, and inferior angle. Fractures of the coracoid process, and of the neck of the scapula, are not common; for, though these parts may appear in the skeleton likely to be often broken, their deep situation in the living subject generally saves them. Indeed, as Boyer says, they generally require great violence to break them, and then the contusion of the soft parts is a worse injury than the fracture itself: thus, this author has seen the coracoid process broken by the blow of the pole of a carriage, and the patient lost his life from the violence at the same time inflicted upon all the soft parts about the shoulder. (*Mal. Chir.* t. iii. p. 161.) The acromion is more frequently broken than any other part of the scapula, and the accident is most commonly produced by a blow, or fall on the shoulder. The fracture is almost always transverse, and may occur either towards the apex, or base of the acromion. The outer fragment is drawn downward by the weight of the arm, and the contraction of the deltoid muscle, while the trapezius and levator scapulæ draw the rest of the bone upward and backward. The roundness of the injured shoulder is lost, and part of the attachment of the deltoid being broken off, the head of the os humeri sinks towards the axilla, as far as the capsular ligament will permit. On tracing the acromion from the spine of the scapula to the clavicle, the surgeon will feel a depression just at their junction. The distance from the sternal end of the clavicle to the extremity of the shoulder is lessened. The natural form of the shoulder may be restored by raising the arm by the elbow; but the deformity returns immediately the arm is suffered to fall again. The accident may be distinguished from a dislocation, if the surgeon raise the shoulder by pushing the humerus upwards, when a crepitus will be perceptible to the surgeon's hand applied over the acromion, on the limb being rotated. (*Sir A. Cooper on Dislocations, &c.* p. 455.)

When the lower angle is broken, the serratus major anticus draws it forward, while the rest of the scapula remains in its natural situation; or, if the angular portion be considerable, the teres major, and some fibres of the latissimus dorsi, contribute to its displacement forward and upward.

When the coracoid process is fractured, the pectoralis minor, coraco-brachialis, and short head of the biceps, concur in drawing it forward and downward.

When the neck of the scapula is fractured, the weight of the arm makes it drop down so considerably, as to give the appearance of a dislocation; but, the facility of lifting the os brachii upward, the crepitus, and the falling of the limb downward again, immediately it is unsupported, are circumstances clearly marking that the case is not a dislocation. According to Sir Astley Cooper, the crepitus is best perceived through the medium of the coracoid process. The degree in which the glenoid cavity and the head of the humerus descend, he observes, depends very much upon whether the ligaments, between the under part of the spine of the scapula and the glenoid cavity, are lacerated or not. (*On Dislocations, &c.* p. 459.)

Sometimes great pain, and a crepitus are experienced, on moving the shoulder-joint, after an accident; and yet the spine, the neck of the scapula, and all the above parts, are not broken. In this circumstance, it is to be suspected, either that a small portion of the head of the os brachii, or a little piece of the glenoid cavity of the scapula, is broken off; which latter occurrence, I think, is not very uncommon.

When the inferior angle is broken, the part remains motionless, while the rest of the scapula is moved; and it is so separated, that no mistake can be made.

Fractures of the spine and body of the bone are all attended with a crepitus; and, in the first cases, an irregularily of the injured part may generally be felt.

Fractures of the body of the bone, are mostly accompanied by much contusion of the soft parts, and sometimes by injury of the thoracic viscera. They are always occasioned by direct violence. Sometimes they are vertical, but most commonly transverse. Those of the acromion and lower angle are more troublesome to keep right; but the most serious cases are fractures of the coracoid process and neck of the bone, which cannot be kept right without great difficulty, and are said to be frequently followed by a considerable stiffness of the arm, inability to raise it, its atrophy, and even paralysis. In other respects, the danger of fractures of the scapula depends less upon the solution of continuity in the bone, than the contusion of the soft parts, or injury of the thoracic viscera. However, when the fracture is comminuted, and the splinters are forced into the subscapularis muscle, abscesses may form under the bone, and, according to Boyer, require a perforation to be made in it (*Mal. Chir.* t. iii. p. 165.); a proceeding, which I cannot bring myself to think would ever be judicious, as making a depending opening in the soft parts must be far better practice. In military surgery, the scapula is often injured by sabre-cuts; but, as Dr. Hennen remarks, this bone, when preserved from motion, is found in these cases to unite with great readiness, and without future inconvenience. (*Principles of Military Surgery,* p. 48. ed. 2.)

When the scapula is fractured longitudinally, or transversely, it is merely necessary to fix the arm to the side by means of a bandage, which includes the arm and trunk, from the shoulder to the elbow. Thus, the motions of the shoulder, which are only concomitant with those of the arm, are prevented. A sling, with one or two circles of a roller round the trunk and lower part of the humerus would answer every purpose.

When the inferior angle is broken, and drawn downward and forward by the serratus major anticus, the scapula must be pushed toward the fragment, by inclining the arm itself inward, downward, and forward, where it is to be kept with a roller. The fragment is also to be kept backward as much as possible, with compresses and a roller, and the arm is to be supported in a sling.

The fractured acromion requires the arm to be so raised, that the head of the os brachii will push up the acromion, while an assistant pushes the scapula forward and downward, in a contrary direction to that of the arm. To maintain this position, a circular bandage is to be applied round the arm and body.

Desault used to apply also a wedge-shaped cushion under the axilla, before putting on the bandage, in order to make the head of the os brachii project more upward, on bringing the arm near the side; but Sir Astley Cooper finds that a cushion, so placed, does harm, by throwing the head of the os humeri outward, and widely separating the acromion from the spine of the scapula. He approves of raising the elbow, and keeping the arm fixed. He also relaxes the deltoid muscle, by means of a cushion, put between the elbow and the side, the elbow inclining a little backwards: the limb is to be bound to the chest in this position with a roller. The union may take place by bone, but, owing to the difficulty of maintaining the coaptation, the uniting substance is generally ligamentous. (See *Sir A. Cooper on Dislocations,* p. 455.)

When the coracoid process is fractured, the muscles attached to it are to be relaxed, by bringing the arm forward towards the breast, and confining it there in a sling; while the shoulder is kept downward and forward, and a compress confined just under the broken part, with a roller.

The treatment of a fracture of the neck of the scapula consists in keeping the head of the os humeri outwards, by means of a thick cushion in the axilla; in keeping the glenoid cavity and arm raised with a sling; and in preventing all motion of the arm by binding it to the trunk with a roller. In some of these cases, the apparatus, proposed by Mr. Earle, might be useful. (*Pract. Obs. in Surg.* 1823.)

Fractures of the Clavicle.

This bone, being long and slender, unsupported at its middle, and protected externally only by the integuments, is very often broken. Its serving to keep the scapula at a proper distance from the sternum, and as a point of support for the os brachii, every impulse of which it receives, fully accounts for the fact.

It may be broken at any part; but its middle, where the curvature is greatest, is most frequently the situation of the injury. It is not very often fractured at its scapular extremity. However, a direct force, falling on the shoulder, may break any part of the clavicle, on which it immediately acts; and then the soft parts will be contused, or even lacerated.

A comminuted fracture may be thus occasioned, and, if the violence be very great, the axillary nerves may be injured. Mr. Earle mentions an instance, in which the axillary plexus of nerves was crushed by a comminuted fracture of the clavicle, and paralysis of the arm occasioned. The limb was afterwards incapable of bearing changes of temperature, exposure to cold bringing on sloughing, while immersion of the hand in warm grains, for some time, caused the whole hand and forearm to be covered with vesications. (See *Med. Chir. Trans.* vol. vii. p. 173.; and *Two Lectures on Burns*, p. 6. 8vo. 1832.) The fall of a heavy body on the shoulder often gives rise to a paralysis of the arm. I am not aware of any case, in which the subclavian vessels have been wounded by the spicula of a broken clavicle.

When the fracturing force is applied to the ends of the bone, as in a fall on the point of the shoulder, or on the hands, while the arms are extended, the clavicle may be bent, and fractured so obliquely, that the broken portions protrude through the skin.

The symptoms differ, according as the fracture happens to be situated between the scapular end of the bone and the coraco-clavicular ligaments, or between the insertion of these ligaments, and its sternal extremity. In the first case, the two fragments being fixed by the ligamentous bands, which connect them on one side with the coracoid process, and, on the other, with the acromion, are but little or not at all displaced; and the arm may yet have in the clavicle a sufficient point of support for the execution of its motions. Still, on careful examination, the outer end of the bone will be perceived to be somewhat depressed; but, if the humerus and shoulder be pushed up, it will assume the same direction as the rest of the bone. A crepitus is also generally distinguishable, when the surgeon applies his hand to the place of the fracture, and alternately raises and depresses the shoulder.

In the second, and far more frequent, case, or that in which the fracture is situated between the insertion of the coraco-clavicular ligaments, and the sterno-clavicular articulation, the displacement is much more considerable; and be it remembered, that the external portion of the clavicle is always that which is displaced. The internal part cannot be moved out of its natural situation, by reason of the costo-clavicular ligaments, and of its being drawn in opposite directions, by the sterno-cleido-mastoideus, and pectoralis major, muscles. The external portion, drawn down both by the weight of the arm, and the action of the deltoid muscle, and forward and inward by the pectoralis major, is carried under the internal portion, which projects over it. The broken clavicle no longer keeping the shoulder at a due distance from the sternum, the arm falls forward towards the breast. The patient finds it impossible to put his hand to his forehead, because this act makes a semicircular motion of the humerus necessary, which cannot be done while that bone has not a firm point of support. The shoulder and upper extremity may be observed to be nearer the breast, than those of the opposite side. The motion of the pieces of bone on one another may be felt, as well as the projection of the end of the internal portion. When the shoulder is moved, a crepitus may also be perceived; but this is productive of great pain, and the diagnosis is so obvious, that it is quite unnecessary.

For the reduction, the two indications are, to push outwards and backwards the scapular fragment, and to bring it to the level of the sternal part.

The ancients, and many moderns, have supposed, that, in order to set a fracture of the clavicle, the shoulder should be drawn back, and fixed in that position. The patient was placed on a low stool, so that an assistant might put his knee between the shoulders, which he drew back at the same time with both hands, while the surgeon applied the bandage which was to keep the parts in this position. But, when the shoulders are thus drawn towards one another, the scapula is obviously pushed towards the sternum, and with it the external portion of the clavicle, which passes under the internal fragment.

The figure of 8 bandage has commonly been used for maintaining the parts in this position. While the assistant keeps back the shoulders, as above described, the surgeon is to apply one end of a roller to the armpit on the side affected, and then make it cross obliquely to the opposite shoulder, round which it is to pass, and from this to the other shoulder, about which it is to be applied in the same manner, and afterwards repeatedly crossed before and behind. The tightness, with which it is necessary to apply this bandage, produces excoriation about the armpits, and the effect is to make the ends of the fracture overlap each other; the very thing which it is wished to avoid. Boyer remarks, that the iron cross proposed by Heister, the corslet described by Brasdor in the *Mém. de l'Acad. de Chir.*, and the leather strap recommended by Brunninghausen, are only modifications of the figure of 8 bandage, and are not at all better.

Desault advised extension to be made by means of the limb, which is articulated with the fractured bone. This is done by converting the humerus into a lever, by carrying its lower end forward, inward, and upward, pushing the shoulder backward, upward, and outward, and putting a cushion in the armpit to serve as a fulcrum.

Desault used to put in the armpit a hair or flock cushion, five or six inches long, and three inches and a quarter thick at its base. Two strings are attached to the corners of the base, which is placed upward: they cross the back and breast, and are tied on the shoulder of the other arm. The cushion being thus placed in the armpit, and the fore-arm bent, Desault used to take hold of the patient's elbow, and carry it forward, upward, and inward, pressing it forcibly against the breast. By this manœuvre, the humerus carries the shoulder outward, the ends of the fracture become situated opposite each other, and all deformity is removed. An assistant is to support the arm in this position, while the surgeon is to place one end of a roller, nine yards long, in the armpit of the opposite side, and then apply the bandage over the upper part of the arm, and across the back to the same situation. The arm and trunk are to be covered with circles of the roller, as far down as the elbow, drawing the bandage more tightly, the lower it descends. Compresses, dipped in camphorated spirit, having been placed along the fractured bone, Desault took a second roller, of the same length as the first, and put one end of it under the opposite armpit, whence it was carried across the breast over the compress and fracture, then down behind the shoulder and arm, and after having passed under the elbow, upward on the breast. Desault next brought it across to the sound shoulder, under and round which he passed it, for the purpose of fixing the first turn. He then conveyed the roller across the back, brought it over the compresses, carried it down in front of the shoulder and arm, under the elbow, and obliquely behind the back to the armpit, where the application began. The same plan was repeated, until all the roller was spent. The apparatus was secured by pins, and the hand kept in a sling.

Boyer's apparatus for fractured clavicles is more simple than that of Desault. The cushion is to be applied under the arm. The apparatus consists of a girdle of linen cloth, which passes round the trunk on a level with the elbow. It is fixed on by means of three straps and as many buckles. At an equal distance from its extremities are placed externally on each side two buckles, two before and two behind the arm. On the lower part of the arm, is to be laced a piece of quilted cloth, five or six fingers broad. Four straps are attached to it, which correspond to the buckles on the outside of the girdle, and serve both to keep the arm close to the trunk, and from moving either backward or forward.

The methods of Desault and Boyer, though judicious and scientific, are not much adopted in this country. The principles of treatment, inculcated by Desault, however, are excellent; but his manner of bandaging the arm and shoulder is rather complicated, and, in women, particularly inconvenient. We learn, from Dr. Reese, that, in the United States, till very lately, fractured clavicles were almost universally treated on Desault's plan. When the bandage was properly applied, it was found, indeed, adequate to fulfil all the necessary indications; but its complexity, its liability to be deranged, and the pressure it made upon the mammæ in female patients, rendered a substitute for it in many cases desirable. In 1816, Dr. S. H. Coale, of Baltimore, therefore, invented an apparatus, which, in his hands, was entirely successful in bad cases of oblique fracture of the clavicle. It was made of leathern straps, and buckles, performing the triple purposes for which Desault's bandage was adapted; and its simplicity, as well as permanence, together with its adaptation to female patients, has brought it into general use in the southern states of the Union. An improvement on Desault's mode of applying the bandage has been suggested by Dr. Stephen Brown, of New York, and is adopted in many parts of the United States. (See *Am. Med. Recorder*, vol. iv.; and *Reese's Am. ed. of this Dict.*) A simple and good apparatus for fractures of the clavicle, and those of the neck of the scapula, was proposed many years ago by Mr. Earle. (See *Pract. Obs. on Surgery*, p. 187, &c.) It is also calculated for cases of dislocated clavicle, and other injuries of the shoulder.

In England, the common figure of 8 bandage, with a sling, is still very generally preferred, except in oblique, or difficult cases. When the fracture is external to the coraco-clavicular ligaments, it answers perfectly; but, in some other instances, it is prudent to attend more strictly to the indications pointed out by Desault. If surgeons understand why the shoulder should be kept outward, as well as backward and upward, in order to bring the fragments into the best apposition, they will have no difficulty in accomplishing it with a thick wedge-shaped pad, or sling, and a roller; and, if not with these means, at all events with Boyer's or Earle's apparatus.

Whatever method is followed, one principal indication, is always to prevent the weight of the arm from drawing downward the external fragment; and for this purpose, in England, a sling is generally preferred to bandages, or any of the apparatus sold in the shops.

I cannot quit this subject without cautioning surgeons never to fall into the error of supposing the rising end of a broken clavicle to be that which is displaced. Although this is truly in its right situation, it has often been made, by injudicious pressure, to protrude through the integuments, one or two instances of which have fallen under my own observation.

Fractures of the Os Brachii, or Humerus.

This bone may be fractured at any point of its length: at its middle, either of its extremities, or above the insertion of the pectoralis major, latissimus dorsi, and teres major. The last case is termed fracture of the neck of the humerus; but that denomination has not the merit of being strictly anatomical. It is possible, however, that what is strictly called the neck of the humerus, may be fractured, particularly by a gunshot wound. By neck of the humerus, is understood that circular narrowing which separates the tuberosities from the head.

Fractures of this bone may be transverse or oblique, simple or compound. Transverse fractures of it below the insertion of the deltoid muscle, are attended with but little displacement, for the brachialis internus and the triceps, being attached posteriorly and anteriorly to both fragments, counteract one another, and admit only a slight angular displacement. When the fracture takes place above the insertion of the deltoid muscle, the inferior portion is first drawn outward and then upward on the external side of the superior.

Oblique fractures are always attended with displacement, whatever be the part of the bone broken. The inferior portion being drawn upward by the action of the deltoid, biceps, coraco-brachialis, and long portion of the triceps, glides easily on the superior, and passes above its lower extremity. Finally, fractures of the neck of the humerus are always attended with displacement, produced by the action of the pectoralis major, latissimus dorsi, and teres major, which, being attached to the lower portion near its superior extremity, draw it first inward and then upward, in which last direction it is powerfully urged by the biceps, coraco-brachialis, and long portion of the triceps. In this case, the superior portion itself is directed a little outward by the action of the infra-spinatus, supra-spinatus and teres minor, which make the head of the humerus perform a rotatory motion in the glenoid cavity.

The shortening and change in the direction of the limb, the crepitus, which may be very distinctly perceived by moving the broken pieces in opposite directions, the pain, and impossibility of moving the arm, &c., joined to the history of the case, render the diagnosis sufficiently plain.

Fractures of the neck of the humerus, however, are not so easily ascertained, and, from want of attention, have been frequently confounded with dislocations. Yet, the diagnostic symptoms of these two accidents are very different.

On this part of the subject, some admirable observations were made by Dupuytren. Every person, he remarks, who meets either with a dislocation, or a fracture of the upper end of the humerus, has fallen upon the corresponding side of the body; but, the position of the limb at the moment of the fall, has not been the same in both cases; and this difference commonly determines the kind of injury, which is to follow, and furnishes the means of recognising it. If, in falling, the patient separates his arm from the side, and puts out his hand to weaken the effects of the fall, the accident will be a dislocation of the head of the humerus, without fracture. On the contrary, if the arm be kept close to the side, as in an unexpected fall, or when the hand is confined in the breeches pocket, the weight of the body then acts upon the cushion of the shoulder, and if there is any displacement, it arises from a fracture of the head, or upper part of the humerus. If the case be a dislocation, the hand having struck the ground, is usually marked by mud, dirt, abrasions, or ecchymosis: if a dislocation, the violence having operated directly on the cushion of the shoulder, the hand is free from those appearances, and the part of the dress covering the deltoid, presents traces of having come in contact with the ground; or the skin of the shoulder exhibits marks of contusion. In dislocation, ecchymosis is situated at the internal and forepart of the arm; in fracture, it is upon the very cushion of the shoulder. In dislocation, ecchymosis is less frequent than in fracture. In both accidents, the acromion is prominent, but more so in dislocation; and in fracture, the deltoid is shortened, and, as it were, swollen. In fracture, the vacancy under the acromion is less than in dislocation, and the prominence in the axilla much less. In dislocation, there is no crepitation — no ready moveableness of the limb, as in fracture. Dislocation requires greater efforts for its reduction, for the maintenance of which it is sufficient to confine the arm close to the side; but, in fracture of the upper part of the humerus, an apparatus is indispensable to hinder the muscles from reproducing the displacement. A fracture, without displacement, may be mistaken for a simple contusion. The crepitus, and mobility felt in the injured part, on rotating the lower portion of the humerus, are the only means of ascertaining the nature of the accident; but care must be taken not to be deceived by the kind of crackling felt in examining the shoulder after a severe contusion, and which arises from inflammation of the articular surfaces, and a deficiency of synovia. (See *Dupuytren*, in *Clin. Chir.* t. iii. p. 106.)

In a simple fracture of the body of the humerus, the prognosis is generally favourable; but fractures near the elbow are liable to be followed by more or less stiffness of the joint, often very difficult of removal.

In ordinary fractures of the humerus, some practitioners apply two pieces of soap-plaster, which together surround the limb, at the situation where the accident has happened: while others deem such application useless. In University College Hospital, we never resort to it. Extension, if necessary, being made by an assistant, who at once draws the lower portion of the bone downward and bends the elbow, the surgeon is to apply a roller round the limb. The external splint is to extend from the acromion to the outer condyle, and being lined with a soft pad, it cannot hurt the limb by pressure. The internal splint is to reach from the margins of the axilla to a little below the inner condyle, and is to be well guarded with a pad, filled with tow, or any other soft materials.

Some surgeons are content with the application of two splints; but, though the two, above described, are those on which we are to place the greatest reliance, yet, as the cylindrical form of the arm conveniently allows us completely to include this part of the limb in splints, I consider the employment of four better: one on the outside, one on the inside, one on the front, and another on the back of the arm. These are to be carefully fixed in their respective situations by means of tape or a roller. Throughout the treatment, the elbow and whole of the fore-arm are to be quietly and effectually supported in a sling.

Fracture of the Head or Neck of the Os Brachii.

Indisputable facts prove the possibility of the anatomical neck of the bone being fractured, and C. Larbaud showed Bichat the humerus of a young man, aged 17, the head of which bone was accurately detached from its body, by a division which had passed obliquely through the upper part of the tuberosities. Another example, proved by dissection, was recorded by Delpech. (*Chirurgie Clinique.*) An instance of this kind was pointed out to me in the spring of 1821, in St. Bartholomew's Hospital. The patient was a boy, whose elbow had been strongly kept up, on the supposition that the case was a fracture of the neck of the scapula, and, consequently, the irregular end of the humerus formed a remarkable projection in front of the acromion, yet capable of being pushed back, where, however, it would not remain. When the accident is produced by a direct blow or fall on the fleshy part of the shoulder, the deltoid is sometimes contused and affected with ecchymosis. Even blood may be effused from some of the ruptured articular veins, or arteries, and form a collection, which Desault recommended to be speedily opened, though the reason of such practice, as a general thing, must be questionable, because large extravasations of blood about the shoulder are usually very soon absorbed.

Sir Astley Cooper has seen this accident both in old and in young persons; but, according to his observation, it rarely occurs in middle age. In the young, he says, it happens at the junction of the epiphysis, where the cartilage is situated; and, in the old, it arises from the greater softness of this part of the bone. (*On Dislocations, &c.* p. 459.)

An acute pain is experienced at the moment of the fall; sometimes the noise of something breaking is heard. There is always a sudden inability to move the limb, which, left to itself, remains motionless. But, on external force being applied, it readily yields, and admits of being moved, with the greatest ease, in every direction. Such motion is attended with severe pain, and, if carried too far, may cause ill consequences, as has been observed in patients in whom the fracture has been mistaken for dislocation.

Below the acromion a depression is remarkable, always situated lower down than that which attends a dislocation. If we place one hand on the head, while the lower part of the bone is moved in various directions with the other hand; or if, while extension is made, an assistant communicates to the bone a rotatory motion, the following circumstances are perceived. 1. The head of the humerus remains motionless. 2. A more or less distinct crepitus is felt, arising from the two ends of the fracture rubbing against each other. These two symptoms are characteristic of the accident; but the swelling of the joint may prevent us from detecting them.

Sometimes there is no displacement of the ends of the fracture, and then, as most of the symptoms are absent, the diagnosis is still more difficult. In general, however, the ends of the fracture are displaced, and, in this circumstance, it is the lower one, which is out of its proper position, and not the upper one, which is of little extent, and is not acted upon by many muscles.

The displacement is, generally, not very perceptible, in regard to length, unless the fracture be very oblique, and its pointed spiculæ irritate the muscles, and make them contract with increased power; or unless the blow, which was violent, continued to operate after the bone had been broken, and forced the ends of the fracture from their state of apposition. In this way, the body of the humerus has been drawn or driven upward, so as to protrude through the deltoid muscle, and integuments, far above the height of the head of the bone.

But commonly, as Petit observes, the weight of the limb powerfully resists the action of the muscles, and the displacement of the fracture is more liable to be transverse. In this circumstance the lower end of the fracture is displaced outward or inward, and rarely in any other direction. In the most frequent case, the elbow is separated from the trunk, and cannot be brought near it without pain; and in the instance of the bone being displaced outward, the limb has a tendency to the opposite direction. According to Sir A. Cooper, the upper end of the main portion of the humerus sinks into the axilla, where it can be felt, and the deltoid is drawn down by it, so that the roundness of the shoulder is diminished. (*On Dislocations, &c.*, p. 459.)

The reduction takes place of itself, on employing a very little force, methodically directed, according as the fracture is displaced inward or outward. If the surgeon put his hands on the situation of the fracture, it is rather to examine the state of the ends of the broken bone, than to accomplish a thing seldom required, namely, what is implied by the term coaptation.

In the treatment, the three indications are, 1. To render the arm and shoulder immoveable: 2. To bring either outward, or inward, the lower end of the fracture: 3. To draw downward the same.

The following articles composed Desault's apparatus. 1. Two long rollers. 2. Three strong splints, of different lengths, and from two to three inches broad. 3. A cushion, three or four inches thick at one of its ends, terminating at the other in a narrow point, and long enough to reach from the axilla to the elbow. 4. A sling to support the fore-arm. 5. A towel to cover thewhole of the apparatus.

The reduction having been effected, the assistants are to continue the extension. Then the surgeon is to take the first roller, which is to be wet with the liq. plumbi acet. dil., and he is to fix one of its heads by applying two circular turns to the upper part of the fore-arm. The bandage is now to be rolled moderately tight round the arm upward, making each turn overlap two thirds of that which is immediately below it. When the roller has reached the upper part of the limb, it must be doubled back a few times to prevent the folds, which the inequality of the part would create. The bandage is afterwards to be carried twice under the opposite axilla, and the rest of it, rolled up, is to be brought up to the top of the shoulder, and committed to the care of an assistant.

The first splint is to be placed in front, reaching from the bend of the arm, as high as the acromion. The second, on the outside, from the external condyle to the same height. The third, behind, from the olecranon to the margin of the axilla. The cushion, interposed between the arm and thorax, serves as a fourth splint, which becomes useless. An assistant applies these parts of the apparatus, and holds them on by applying his hands near the bend of the arm, in order not to obstruct the application of the remainder of the bandage.

The surgeon takes hold of the bandage again, and applies it over the splints with moderate tightness, and the bandage ends at the upper part of the fore-arm, where it began.

While the assistants still keep up the extension, the surgeon is to place the cushion between the arm and trunk, taking care to put the thick end upward, if the fracture be displaced inward; but downward, if this should be displaced outward, which Desault found most common. Then the cushion is to be fastened with two pins to the upper part of the roller.

The arm is to be brought near the trunk, and fixed upon the cushion, by means of the second roller, applied round the arm and thorax. The turns of this bandage should be rather tight below, and slack above, if the fracture be displaced inward; but, if outward, they should be slack below, and tight above.

The fore-arm is to be supported in a sling, and the whole of the apparatus is to be enveloped in a napkin, which will prevent the bandages from being pushed out of their places.

Should the lower fragment project inward, the thick end of the cushion will remove it farther from the chest. The bone will be kept at this distance from the side by the turns of the bandage, which being tight downward, will act upon the limb as a lever, the fulcrum for which will be the cushion, and the resistance, the action of the pectoralis major, latissimus dorsi, and teres major.

When the lower end of the fracture is drawn outward, the contrary effect will be produced, both from the pressure exercised by the bandage on the upper end of the displaced portion of the bone, and from the situation of the elbow, which is kept outward by the thick part of the cushion. The outer splint will also prevent the lower end of the fracture from being displaced outward, both by its mechanical resistance to the bone, and by its compressing the deltoid muscle, which is the chief cause of such displacement. All displacement of the lower end of the fracture, forward, or backward, is prevented by the back splint; and as for the longitudinal displacement, which is already prevented by the weight of the limb, it is still more effectually hindered by the compression of the muscles of the arm, both by the splints and roller. (See *Œuvres Chir. de Desault*, t. i.)

Sir Astley Cooper recommends a roller to be applied from the elbow to the shoulder joint; two splints to be bound on the inner and outer sides of the arm with a roller; a cushion to be placed in the axilla in order to throw out the head of the bone; and gently supporting the arm in a sling; for if the elbow be much raised, the bones will overlap, and the union be attended with deformity. (*On Dislocations, &c.* p. 461.)

Fractures of the lower End of the Humerus, with Separation of the Condyles.

This accident is not uncommon, and Desault, in particular, had frequent occasion to meet with it. In University College Hospital, I have also noticed some examples of it.

Whatever its causes may be, the two condyles are usually separated from each other by a longitudinal division, which, extending more or less upward, is bounded by another transverse, or oblique division, which occupies the whole thickness of the bone. Hence, there are three different pieces of bone and two fractures.

Sometimes, the division is more simple; as when, taking a direction outward, or inward, it crosses obliquely down the lower end of the humerus, terminates in the joint, and only detaches one of the condyles from the body of the bone.

In the first case, the deformity is greater, and the fractured part is more moveable. When pressure is made, either before, or behind, on the track of the longitudinal fracture, the two condyles, becoming further separated from each other, leave a fissure between them, and the fractured part is widened. The fore-arm is almost always in a state of pronation. On taking hold of the condyles, and moving them in different directions, a distinct crepitus is perceived.

In the second case, the separation of the condyles from each other is not so easy; but a crepitus can always be distinguished, on moving the detached condyle. In one case, in which only the external condyle was broken, Desault found the limb always supine.

In both cases, an acute pain, the almost inevitable effect of bending, or extending, the fore-arm; an habitual half-bent state of this part of the limb, and sometimes a subsequent swelling of it, together with more or less tumefaction round the joint, are observable. When the blow has been violent, or a pointed piece of the bone protrudes through the flesh, the accident may be complicated with a wound, splinters of bone, &c. I have known two cases of this kind, which required amputation.

When the condyles of the humerus are obliquely broken off, just above the joint, the appearances, as described by Sir Astley Cooper, are those of a dislocation of the radius and ulna backwards; but the nature of the case is evinced by the circumstance of the displacement recurring, as soon the extension is stopped, and also by the crepitus, generally perceptible, when the radius is rotated upon the humerus. (*On Dislocations, &c.* p. 481.)

The old writers consider the communication of a fracture with a joint, a fatal kind of complication. Swelling and inflammation of the adjacent parts; continuance of pain after the reduction; large abscesses; even mortification of the soft parts, and caries of the bones, are, according to such authors, the almost inevitable consequences of these fractures, and anchylosis the most favourable termination. Paré, Petit, Heister, Duverney, all give this exaggerated picture. However, analogous fractures of the olecranon and patella prove, that this representation is magnified beyond truth.

The detached condyles, being drawn in opposite directions by the muscles of the arm and fore-arm, commonly remain unmoved between these two powers, and are but little displaced. External force may, however, put them out of their proper situation, and they may then be displaced forward, or backward, or they may separate from each other sideways, leaving an interspace between them. Hence, the apparatus should resist them in these four directions; and this object is easily accomplished by means of four splints, kept on with a roller. The two lateral splints are particularly necessary, when the condyles are separated from the body of the bone, with an interspace between them. If one of them be still continuous with the humerus, no splint on this side will be requisite.

Desault recommends the front and back splints to be flexible at their middle part, which should be applied to the bend of the arm and elbow.

The treatment, advised by Sir Astley Cooper, consists in bending the arm, drawing it forwards so as to reduce the parts, and then applying a roller. The best splint for this case is one formed at right angles, the upper portion of it being placed behind the upper arm, and the lower under the fore-arm. He also directs the application of a splint to the fore part of the upper arm. The splints are to be fixed with straps; evaporating lotions used; and the arm kept in a bent position in a sling. In a fortnight, if the patient be young, and, in three weeks, if he be an adult, passive motion may be gently employed for the purpose of hindering an anchylosis. (*On Dislocations, &c.* p. 482.) According to this distinguished surgeon, when the internal condyle is broken off obliquely, the ulna loses its natural support, and projects backward.

Fracture of the Fore-arm.

The fore-arm is more frequently broken than the arm, because external force operates more directly upon it than the latter part, especially in falls on the hands, which are frequent accidents. Bichat, in his account of Desault's practice, mentions, that fractures of the fore-arm often held the first place in the comparative table of such cases, kept at the Hôtel-Dieu.

We know, that the fore-arm is composed of two bones, the ulna and radius. The last is much more liable to fractures than the first, because it is articulated with the hand by a large surface, and all the shocks, received by the latter part, are communicated to it. The situation of it also more immediately exposes it to such causes as may break it. However, both the bones are frequently broken together.

Fractures of both Bones,

May occur at the extremities, or middle of the fore-arm. They are frequent at the middle, very common below; but, seldom happen at the upper part of it, where the numerous muscles, and the considerable thickness of the ulna, resist causes, which would otherwise occasion the accident. The bones are usually broken in the same line, but sometimes in two different directions. The fracture is almost always single; but, in a few instances, it is double: Desault was one day called to a patient, over whose fore-arm the wheels of a cart had passed, so as to break the bones, at their middle and lower part, into six distinct portions. The middle ones, notwithstanding they were quite detached, united very well, with hardly any deformity.

Baron Dupuytren, in all his extensive practice, never met with a dislocation of the wrist; but the great frequency of fractures of the radius is convincingly proved by some records, to which he refers. In 1829, out of 109 fractures brought to the Hôtel-Dieu, 23 were of the fore-arm, 16 being of the radius, 5 of both bones, and 2 of the ulna. In 1830, in 97 fractures, 22 were of the fore-arm, 16 being of the radius alone, 4 of both bones, and 2 of the ulna. Fractures of the lower end of the radius, the cases apt to be mistaken for dislocations, seem to occur at all ages; for, in 14 examples, alluded to by Dupuytren, the ages of the patients varied between 8 and 88; but, in young subjects, a separation of the epiphysis is more likely to occur than a fracture. Several instances of this fact have presented themselves in University College Hospital. The right radius appears to be more frequently broken than the left; for, in 97 cases, 59 happened to the right arm. (See *Clin. Chir.* t. iv. p. 181.)

These accidents are most commonly occasioned by direct external violence; but, sometimes they are produced by a counter-stroke, which is generally the case, when the patient falls on his hand. But, in this instance, as the hand is principally connected with the lower broad articular surface of the radius, this bone alone has to sustain almost the whole shock of the blow, and hence is usually the only one broken.

In 14 examples of broken radius, referred to by Dupuytren, 3 were caused by falls upon the back of the hand; and 11 by falls upon the palm. These facts refute one of Cruveilhier's inferences, that the radius cannot be fractured by a fall upon the back of the hand. (*Clin. Chir.* t. iv. p. 182.)

The symptoms indicating fractures of the fore-arm are not likely to lead the surgeon into any mistake; motion at a part of the limb, where it was previously inflexible; a crepitus, almost always easily felt; sometimes a distinct depression in the situation of the fracture; occasionally a projection of the ends of the fracture beneath the skin; pain on moving the part; a noise sometimes audible to the patient at the moment of the accident; an inability to perform the motion of pronation and supination; and an almost constantly half-bent state of the fore-arm.

There is one case, however, in which, the fracture being very near the wrist-joint, similar appearances to those of a dislocation may arise; which last accident, with respect to the radio-carpal articulation, however, is one of great rarity. (See Dislocation.) But attention to whether the styloid processes are above, or below, the deformity, will discover whether the case be a fracture, or dislocation. In a fracture, the part is also more moveable, and there is a crepitus. (*Œuvres Chir. de Desault*, t. i.) According to Boyer, the two cases may be distinguished by simply moving the hand; by which motion, if there be a luxation without fracture, the styloid processes of the radius and ulna will not change their situation; but, if a fracture exist, they will follow the motion of the hand.

The connection of the two bones of the fore-arm, by the interosseous ligament, which occupies the interspace by which they are separated, and the manner in which the muscles attached to both are inserted into them, render any displacement of the broken pieces in the longitudinal direction very difficult; and, in reality, such displacement is seldom observed, and never in any considerable degree. When it does take place, it is to be ascribed to the cause of the fracture, rather than to muscular contraction. On the contrary, in the transverse displacement, the four pieces approach one another, and the interosseous space is diminished, or entirely obliterated near the seat of the fracture; attended with evident deformity of the part. There is likewise an angular displacement, which the fracturing cause always produces, either forward or backward.

In the treatment of a fracture of both bones, the fore-arm is to be bent to a right angle with the arm, and the hand placed in a position between pronation and supination. An assistant then takes hold of the patient's four fingers, and extends the fractured parts, while another assistant makes counter-extension by fixing the humerus with both his hands. By these means, the operator is enabled to restore the bones to their natural situation, and to push the soft parts into the interosseous space, by a gentle and graduated pressure on the anterior and posterior sides of the arm.

Boyer used to keep the bones in their place by applying first on the anterior and posterior sides of the fore-arm two longitudinal and graduated compresses, the base of which was in contact with the arm. The depth of these compresses should be proportioned to the thickness of the arm, increasing as the diameter of the arm diminishes.

Boyer also employed a single-headed roller, and made three turns of it on the fractured part; then descending to the hand by circles partially placed over one another, and enveloping the hand by passing the bandage between the thumb and index finger. The bandage was next carried upward in the same manner, and reflected, wherever the inequality of the arm might render it necessary. The compresses and bandage being thus far applied, he laid two splints, one anteriorly, the other posteriorly, and applied the remainder of the bandage over them. The compresses and splints should be of the same length as the fore-arm. It would be useless to employ lateral splints. They would counteract the compresses and two other splints, by lessening the radio-cubital diameter of the arm, and, with the aetion of the pronators, tend to push the ends of the fracture into the interosseous space. The surgeon's attention should be particularly directed to preserve the interosseous space; for, if this be obliterated, the radius cannot rotate on the ulna, nor the motion of pronation or supination be executed; and this object may be obtained with certainty by applying the compresses and splints in such a manner, that the fleshy parts may be forced into, and confined in, the interosseous space, and by renewing the bandage every seven or eight days. In general, the longitudinal compresses, used by Boyer, for preserving the interosseous space, are not resorted to in England, where care is taken not to let the circles of the roller on the fore-arm be too tight, which would have the injurious effect of compressing the ends of the fracture into the interosseous space.

If the fracture be simple, and the contusion inconsiderable, the patient need not be confined to bed, but may walk about, with his arm in a sling.

Fractures of the Radius

Are the most frequent of those of the fore-arm, as proved by records noticed in the foregoing section. The radius being almost the sole support of the hand, and placed in the same line with the humerus, is, for both these reasons, more exposed to fractures than the ulna. These, whether transverse or oblique, near its middle part or extremities, may be caused by a fall or blow on the fore-arm: sometimes by a fall on the back of the hand (see *Dupuytren, Clin. Chir.* t. iv. p. 182—184.), or, as happens in most cases, by a fall on the palm of the hand. When likely to fall, we extend the arm, and let the hand come first to the ground; in which case, the radius, pressed between the hand on the ground, and the humerus, from which it receives the whole momentum of the body, is bent, and, if the fall be sufficiently violent, broken more or less near its middle part. When, after an accident of this kind, pain, and difficulty of performing the motions of pronation and supination supervene, the probability of a fracture of the radius is very strong. The truth is fully ascertained by pressing with the fingers along the external side of the fore-arm. Also, in endeavouring to perform supination or pronation of the hand, a crepitus and a motion of the broken portions will be perceived. When the fracture takes place near the head of the radius, the diagnosis is more difficult, on account of the depth of soft parts over that part of the bone. In this case, the thumb is to be placed under the external condyle of the os humeri, and on the superior extremity of the radius, and at the same time the hand is to be brought into the prone and supine positions. If, in these trials, which are always painful, the head of the radius rests motionless, there can be no doubt of the bone being fractured. Here the causes of displacement are the same as in fractures of the fore-arm; it can never take place, except in the direction of the diameter of the bone, and is effected principally by the action of the pronating muscles. The ulna serves as a splint in fractures of the radius; and the more effectually, as the two bones are connected with one another throughout their whole length.

Fractures of the lower end of the radius deserving particular notice, as often erroneously supposed to be dislocations of the wrist, may be transverse, or oblique, and be situated from three to six lines, or an inch, from the articular surface. The consecutive displacement will have a greater resemblance to a true dislocation, the nearer the fracture is to the wrist. Dupuytren met with some cases, in which the artieular surface of the radius was comminuted. In general, fractures of the lower end of the radius take an oblique direction from above downwards, and from the dorsal to the palmar surface. (See *Clin. Chir.* t. iv. p. 183.) Such fractures are mostly simple; but now and then compound. Occasionally the lower fragment is split vertically in two pieces. In a few rare cases, besides a fracture of the radius, the ulna is dislocated, and projects through the skin. (*Dupuytren*, vol. cit. p. 190.)

In general, when the radius alone is fractured, no extension is requisite. During the treatment, the elbow is to be bent, and the hand put in the mid-state, between pronation and supination; that is to say, the palm of the hand is to face the patient's breast. Having reduced the ends of the fracture, when they appear to be displaced, the soap-plaster is to be applied, and over this a slack roller. This bandage is, indeed, of no utility; but it makes the limb seem to the unknowing bystanders more skilfully put up, than if it were omitted, and, as it does no harm, the surgeon may honestly apply it. However, no one can doubt, that tight bandages may act very perniciously, by pressing the radius and ulna together, causing them to grow to each other, or, at all events, making the fracture unite in an uneven manner. Only two splints are necessary; one is to be placed along the inside, the other along the outside, of the fore-arm. Soft pads must always be placed between the skin and the splints, in order to obviate the pressure of the hard materials, of which the latter are formed. The inner splint should extend to about the last joint of the fingers; but not completely to the end of the nails; for many patients, after having had their fingers kept, for several weeks, in a state of perfect extension, have been a very long time in becoming able to bend them again.

Sometimes, it may be proper to apply a compress just under the ends of the fracture, to prevent their being depressed towards the ulna too much, the consequence of which has occasionally been the loss of the prone and supine motions of the hand.

In setting a fractured radius, the hand should be inclined to the ulnar side of the fore-arm. When the fracture is towards the wrist, the hand

and lower fragments have a tendency to displacement outwards, towards the radial side of the fore-arm. If attention be not paid to prevent this, the union takes place with deformity, and the motions of supination and pronation are imperfect. (See *Dupuytren, Clin. Chir.* t. iv. p. 214.) The mechanical contrivances, employed by this celebrated surgeon to keep the hand in the right position, are there described.

Fractures of the Ulna

Are less frequent than those of the radius, and take place generally at its lower extremity, which is most slender, and least covered. The fracture is almost always the result of a force acting immediately on the part fractured; as, for instance, when, in a fall, the internal side of the fore-arm strikes against a hard resisting body. On applying the hand judiciously to the inside of the fore-arm, this fracture is easily ascertained by the depression at that part, in consequence of the interior portion being drawn toward the radius by the action of the pronator radii quadratus. This displacement, however, is less considerable than what takes place in fractures of the radius. The superior portion of the ulna remains unmoved. (*J. L. Petit.*)

In this case, the assistant, who makes whatever little extension may be necessary, should incline the hand to the radial side of the fore-arm, while the surgeon pushes the flesh between the two bones, and applies the apparatus, as in the preceding case. In all fractures of the bones of the fore-arm, and, particularly in those which are near the head of the radius, a false anchylosis is to be apprehended, and should be guarded against by moving the elbow gently and frequently, when the consolidation is advanced to a certain point.

Fractures of the fore-arm always require the part to be kept quietly in a sling.

Fractures of the Olecranon

Happen either at its base, its centre, or its extremity; but, the second case is the most frequent. The division is almost always transverse, though occasionally oblique. The accident is very rarely produced by the action of the muscles, but almost always, by external violence, directly applied to the part in a blow, or fall upon the elbow.

With regard to symptoms, the contraction of the triceps, being no longer resisted by any connection with the ulna, draws upward the short fragment, to which it adheres, so as to produce, between it and the lower one, a more or less evident interspace. This interspace is situated at the back of the joint, and may be increased or diminished at will, by augmenting the flexion of the fore-arm, and putting the triceps into action, or extending the limb. Another symptom is a difficulty, or impossibility of extending the fore-arm, the necessary effect of the detachment of the triceps from the ulna. It appears from the dissections made by Sir Astley Cooper, that the extent of the separation depends upon the degree of laceration of the capsular ligament, and of that portion of ligament which proceeds from the side of the coronoid process to that of the olecranon. (*On Dislocations, &c.* p. 487.) It must be owing to the untorn state either of the latter part, or of the aponeurosis covering the olecranon, that patients occasionally retain the power of extending the fore-arm, as is exemplified in the case reported by Mr. Earle, where, on the sixth day after the accident (and not before), this power was destroyed by a sudden flexion of the fore-arm. (*Practical Obs.* p. 147.) The fore-arm is constantly half-bent, the biceps and brachialis having no antagonists. The olecranon is more or less drawn up higher than the condyles of the humerus, which latter parts, on the contrary, are naturally situated higher than the olecranon, when the fore-arm is half-bent. The upper piece of bone may be moved in every direction, without the ulna participating in the motion. Besides these symptoms, we must take into the account, the considerable pain experienced, and the crepitus perceptible, when the fragment is approximated to the surface from which it is detached.

The indications are to push the retracted portion of the olecranon downwards, and to keep it in this position, at the same time that the ulna is made to meet it, as it were, by extending the fore-arm. According to Desault, however, the fore-arm should not be completely extended, as, when the pieces of bone touch at their back part, they leave a vacancy in front, which is apt to be followed by an irregular callus, prejudicial to the free motion of the elbow. Hence, it was his practice to put the arm between the half-bent and the completely extended state, and to maintain this posture by means of a splint along the fore part of the arm. But, as position operates only on the lower part of the olecranon, the upper one requires to be brought near the former, and fixed there, which is, doubtless, the most difficult object to effect, because the triceps is continually resisting.

Desault used to adopt the following method:—The fore-arm being held in the above position, the surgeon is to begin applying a roller round the wrist, and to continue it as high as the elbow. The skin, covering this part, being wrinkled in consequence of the extension of the limb, might insinuate itself between the ends of the fracture, and consequently it must now be pulled upward by an assistant. The surgeon is then to push the olecranon towards the ulna, and confine it in this situation with a turn of the roller, with which the joint is then to be covered, by applying it in the form of a figure of 8.

A strong splint, a little bent, just before the elbow, is next laid along the arm and fore-arm, and fixed by means of a roller. The limb is then to be evenly supported on a pillow.

The cure of the fractured olecranon is seldom effected by the immediate reunion of its fragments; there generally remains a greater or lesser interspace between them, which is filled up by a substance, not of a bony consistence. Indeed, the tenour of the remarks and experiments lately published by Sir Astley Cooper on this subject, is to represent the broken olecranon as similarly circumstanced with respect to bony union, as the fractured neck of the femur. He has seen union by bone effected in the living subject; but this was when the fracture had taken place very near the shaft of the ulna. The ligamentous substance, he says, which generally forms the bond of union, when it is of considerable length, often has one, or even several apertures in it. The arm is observed to be weakened, in proportion to the length of the ligament. (*On Dislocations, &c.* p. 489.)

Camper laid great stress upon the inutility of keeping the arm perfectly extended; he found patients recover sooner and better, when the elbow was kept half bent, and the joint gently exercised at as early a period as possible. "Agglutinationem scilicet motiri non debet chirurgus, sed sublatis tumore ac inflammatione quiete et remediis aptis, cubitum quotidie prudenter movere, ut unio per tricipitis tendinem, seu per concretionem membranosam formetur, et os ossi non admoveatur. Verbo quemadmodum C. Celsus in *Med.* lib. viii. c. 10. § 4. p. 537. de cubito fracto præcepit. Quod si ex summo cubito quid fractum sit, glutinare id vinciendo alienum est, fit enim brachium immobile, ac, si nihil aliud quam dolore occurrendum est, idem qui fuit ejus usus est." (*Camper de Fracturâ Patellæ*, p. 66. Hagæ, 1789.) Mr. Earle is also an advocate for placing the limb in a slightly bent position. (*Pract. Obs.* p. 165.) The late Mr. Sheldon, however, does not concur with Desault and Camper, respecting the position of the limb during the treatment, but insists upon the utility of keeping the fore-arm perfectly extended.

When there is much swelling, Sir A. Cooper employs leeches and evaporating lotions for two or three days; but, when not much violence has been done to the limb, he applies a bandage at once. He places the arm in a straight position, presses down the fragment until it touches the ulna, and, after putting a slip of linen along each side of the joint, puts a roller round the limb above and below the olecranon. By tying the slips of linen, which pass under the rollers, these are drawn nearer together, and the fragment of the olecranon is thus kept as near as possible to the ulna. Lastly, a splint, well padded, is applied along the front of the arm, and secured with a bandage, which is frequently wetted with spirit of wine and water. (*On Dislocations, &c.* p. 490.)

Baron Dupuytren applied what is termed the uniting bandage, with a compress above the upper fragment, and an anterior splint. (See *Clin. Chir.* t. i. p. 328.)

On an average, the olecranon becomes firmly united about the twenty-sixth day. (*Desault.*) In a month, the splint is to be removed, and passive motion begun. (*A. Cooper.*) I have seen a case, in which the upper fragment was anchylosed to the humerus.

Fracture of the Coronoid Process.

Two examples of this accident are noticed by Sir Astley Cooper: in one case, seen by him several months after its occurrence, the same appearances presented themselves as were remarked by the surgeon who first attended the patient; namely, the ulna projected backwards whilst the arm was extended, but it could be drawn forwards, and the elbow bent, without much difficulty, when the deformity disappeared. In the other instance, which was met with in the dissection-room, the coronoid process, which had been broken off, was united by ligament, and so moveable, that, when the fore-arm was extended, the ulna glided backwards upon the condyles of the humerus. Sir Astley Cooper is of opinion, that the case admits of no other mode of union: he recommends keeping the arm steadily in the bent position for three weeks. (*On Dislocations, &c.* p. 484.)

Fractures of the Carpal and Metacarpal Bones, and Phalanges of the Fingers.

The bones of the carpus, when broken, are usually crushed, as it were, between very heavy bodies, or the limb has been entangled in powerful machinery, or suffered gunshot violence. It must be obvious, therefore, that, as the soft parts are also seriously injured, these cases are generally followed by severe and troublesome symptoms, and sometimes require the performance of amputation, either immediately or subsequently. When an attempt is to be made to save the part, the chief indications are to extract splinters of bone, and prevent inflammation, abscesses, and mortification. The parts may at first be kept wet with a cold evaporating lotion, any wound present being lightly and superficially dressed; but, afterwards, as soon as all tendency to bleeding is over, emollient poultices may be applied over the dressings instead of the lotion. The dressings themselves, however, should not be removed for the first three or four days, all unnecessary disturbance of the crushed parts being highly injurious. Should abscesses form, early openings should be practised, so as to prevent the matter from extending up the fore-arm. Duly supporting the hand and fore-arm in a sling is of the greatest importance. The metacarpal bones of the little finger and thumb are more frequently broken than the other three. A fracture of a metacarpal bone is generally produced by violence applied directly to the part, as no force, capable of causing the accident, can well act upon the two ends of the bone so as to break it. The fracture may be simple, but more commonly it is compound, the soft parts being wounded and lacerated by the same violence which has injured the bone. In most cases, also, unless the force has operated by a very limited surface, more than one metacarpal bone is fractured. At first, the same kind of treatment is requisite as in the preceding cases, and, after the inflammation has subsided, a hand-board, or splint, may be employed. When the hand is very badly crushed, amputation is indicated.

In fractures of the finger-bones, the treatment consists in applying pasteboard, or placing the hand on a flat splint, or finger-board, and keeping the part at rest in a sling.

For *Fractures of the Cranium*, see Head, *Injuries of.*

For information on fractures generally, consult *J. L. Petit*, Traité des Maladies de Os. 8vo. Paris, 1723. et nouv. ed. par *M. Louis*, 2 t. 12mo. 1767. *Duverney*, Traité des Maladies des Os. 8vo. Paris, 1751. *Jonathan Wathen*, The Conductor and Containing Splints; or a Description of two new-invented Instruments, for the more safe Conveyance, as well as the more easy and perfect Cure, of Fractures of the Leg, 2d ed. 8vo. Lond. 1767. *W. Sharp*, in vol. lvii. of the Philosophical Trans. part ii. 1767. *Pott*, on Fractures and Dislocations, 2d ed. 1773. *T. Kirkland*, Obs. upon Pott's General Remarks on Fractures, &c. 8vo. Lond. 1770; also, Appendix to the same, 8vo. Lond. 1771. Cases in Surgery, by *C. White*, edit. 1770. *J. Aitken*, Essays on several Important Subjects in Surgery, chiefly on the Nature of Fractures of the Long Bones of the Extremities, 8vo. 1771. *Boyer*, Traité des Mal. Chir. t. iii. Œuvres Chir. de *Desault*, par *Bichat*, t. i. Parts of the Parisian Chir. Journal. *Sir J. Earle*, Obs. on Fractures of the Lower Limbs; to which is added, an Account of a Contrivance to administer Cleanliness and Comfort to the Bed-ridden, or Persons confined to Bed by Age, Accident, Sickness, or other Infirmity, 8vo. Lond. 1807. *Assalini*, Manuale di Chirurgia, parte prima, Milano, 1812. *M. le Baron Dupuytren*, Des Fractures ou Courbures des Os des Enfans, in Bulletin de la Faculté de Méd. Paris, 1811. *Idem*, Sur la Fracture de l'Extrémité inférieure du Péroné, les Luxations, et les Accidens qui en sont la suite, in Annuaire Méd. Chir. de Paris, 4to. Paris, 1819. Also, on Fractures of Various Bones, in Leçons Orales de Clin. Chir. 4 tomes, 8vo. Paris, 1832—1834. *M. Roux*, Relation d'un Voyage fait à Londres en 1814, ou Parallèle de la Chir. Angloise avec la Chir. Françoise, p. 173, &c. Paris, 1815. Med. Chir. Trans. vol. ii. p. 47, &c.; vol. v. p. 358, &c.; vol. vii. p. 103. Sketches of the Medical Schools of Paris, by *J. G. Crosse*, p. 87, &c. *Sir Astley Cooper*, on Dislocations and Fractures of the Joints, 4to. Lond. 1822; and Obs. on Fractures of the Neck of the Thigh-Bone, 1823. *H. Earle*, Practical Obs. in Surgery, 8vo. 1823. *W. Gibson's* Institutes and Practice of Surgery, 8vo. vol. i. Philadelphia, 1824. *Sir C. Bell*, on Injuries of the Spine and Thigh-Bone, 4to. Lond. 1824. *J. Amesbury*, on Fractures of the Upper Third of the Thigh-Bone, and Fractures of long standing, ed. 2. 8vo. Lond. 1829. *G. W. Hind*, a Series of Plates, illustrating the Causes of Displacement in the Various Fractures of the Bones of the Extremities, fol. 1835.

FRÆNUM LINGUÆ. In infants, the tongue is sometimes too closely tied down, by reason of the frænum being extremely short, or continued too far forwards. In the latter case, the child will not be able to use its tongue with sufficient ease in the actions of sucking, swallowing, &c., in consequence of its point being confined at the bottom of the mouth. Though this affection is not unfrequent, it is less common than is generally supposed by parents and nurses. When the child is small, and the nurse's nipple large, it is common for her to suppose the child to be tongue-tied, when, in fact, it is only the smallness of the child's tongue that prevents it from surrounding the nipple, so as to enable it to suck with facility. Mothers also commonly suspect the existence of such an erroneous formation, whenever the child is long in beginning to talk.

The reality of the case may always be easily ascertained by examining the child's mouth. In the natural state, the point of the tongue is always capable of being turned upward, towards the palate, as the frænum does not reach along above a quarter of an inch of the lower part of the tongue from the apex. But, in tongue-tied children, by looking upon one side, we may see the frænum extending from the back part to the very point, so that the whole length of the tongue is tied down, and unnaturally confined.

The plan of cure is to divide as much of the frænum as seems proper for setting the tongue at liberty. The surgeon presses up the tongue against the palate with his left thumb and fore-finger. The incision should be directed downwards, away from the tongue, and not be carried upward, or backward, lest the raninal veins, or arteries be cut; an accident that has been known to prove fatal. For the same reason, the scissors used for this operation should have no points. If the fore-finger and thumb prevent the parts from being seen, the tongue must be pressed up with a spatula, or a director, that has a slit in which the frænum may be placed, as long ago preferred by J. L. Petit. (See *M. Velpeau*, in *Nouv. Elém. de Méd. Op.* t. ii. p. 67. 8vo. Paris, 1832; and *M. Malgaigne, Manual de Méd. Opér.* p. 465. ed. 2. 12mo. Paris, 1837.) I think the following piece of advice, offered by a modern author, may be of service to practitioners, who ever find it necessary to divide the frænum linguæ: "It is not the relations of the trunk of the lingual artery alone, which the student ought to make himself acquainted with. He will do well to study the position of the arteria ranina in respect to the frænum linguæ. This information will teach him the impropriety of pointing the scissors upward and backward, when snipping the frænum; an operation, by the by, oftener performed than needed. He will learn, that the ranular artery lies just above the attachment of the frænum; so that, if he would avoid it, he must turn the points of the scissors rather downward; if he do not, the artery will probably suffer." (*A. Burns, Surgical Anatomy of the Head and Neck*, p. 239.)

When an infant has the power of sucking, this proceeding should never be resorted to, even though the frænum may have the appearance of being too short, or extending too far forwards. (*Fab. Hildanus*, centur. iii. obs. 28. *Petit, Mal. Chir.* t. iii. p. 265. edit. 1774.)

Although the operation of dividing the frænum linguæ is, for the most part, done without any bad consequences, surgeons should remember well, that it is liable to dangers, especially when performed either unnecessarily or unskilfully. Besides the fatal events which have occasionally resulted from wounding the raninal arteries, the records of surgery furnish us with proofs, that the mere bleeding from the raninal veins, and the small vessels of the frænum, may continue so long in consequence of the infant's incessantly sucking, as to produce death. In such cases, the child swallows the blood as fast as it issues from the vessels, so that the cause of death may even escape observation. But, if the body be opened, the stomach and intestines will be found to contain large quantities of blood. (See *Dionis, Cours d'Opérations de Chirurgie*, 7e Démonstration. *Petit, Maladies Chir.* t. iii. p. 282, &c.)

Another accident, sometimes following an unnecessary or too extensive a division of the frænum, consists in the tongue being thrown backward over the glottis into the pharynx, where it lies fixed, and causes suffocation. The observations of Petit on this subject are highly interesting. (See *Op.* cit. t. iii. p. 267, &c.)

Lastly, it should be known, that an infant's inability to move its tongue, or suck, is not always owing to a malformation of the frænum. Sometimes the tongue is applied and glued, as it were, to the roof of the mouth, by a kind of mucous substance; and, in this case, it should be separated with the handle of a spatula. By this means, infants have been saved, which were unable to suck during several days, and were in imminent danger of perishing from want of nourishment. (See *Mém. de l'Acad. de Chir.* t. iii. p. 16. ed. 4to.)

See particularly *Petit*, Traité de Maladies Chir. t. iii. p. 260, &c. *Dionis*, Cours d'Opérations, 7e Démonstr. *Sabatier*, Médecine Op. t. iii. p. 132, &c. *Lassus*, Pathologie Chir. t. ii. p. 454. *Richter*, Anfangsgr. der Wundarzn. b. iv. kap. ii. p. 11. ed. 1800. Also, *A. L. M. Velpeau*, Nouv. Elém. de Méd. Op. t. ii. p. 65. 8vo. Paris, 1832. *J. F. Malgaigne*, Manuel de Méd. Op. p. 464. 12mo. ed. 2. Paris, 1837.

FRAGILITAS OSSIUM. A morbid brittleness of the bones. Although it may take place at different periods of life, it is remarked to be more common in childhood and in persons of advanced age. (See *B. Bell on Diseases of the Bones*, p. 74.)

Boyer imputes *mollities ossium* to a deficiency of lime in their structure; *fragilitas ossium* to a deficiency of the soft matter naturally entering into their texture. This is not the view usually adopted. One modern writer considers preternatural brittleness and flexibleness of the bones, as the results of different degrees of the same cause. One degree produces brittleness; a greater degree flexibleness, with greater brittleness; the most aggravated form, mollities ossium. (See *Mayo's Human Pathology*, p. 19.) The diseases, termed *rickets* and *mollities*, however, as we shall find by a reference to those articles, are at all events combined with other pathological changes and circumstances. Boyer states, that a certain degree of fragilitas ossium necessarily occurs in old age, because the proportion of lime in the bones naturally increases as we grow old, while that of the organized part diminishes. Hence, the bones of old persons more easily break than those of young subjects, and are longer in uniting again. In old age, the cortex of the bones is thinner, and both in it and the cancelli, the quantity of phosphate of lime diminished. This is one cause of the frequency of fracture of the neck of the thigh-bone in elderly persons. (See *Mayo, Op.* cit. p. 17.) As Mr. Wilson observes, however, they never are found so friable and fragile, as to crumble like a calcined bone, but, on the contrary, they contain a large quantity of oil; a fact particularly noticed by Saillant (see *Hist. de la Société de Méd.* 1776. p. 316.); and when dried after death, they are so greasy as to be unfit to be preserved as preparations. Their organized vascular part is diminished, but their oily animal matter is increased. (*On the Skeleton and Diseases of Bones*, p. 258.)

In persons who have been long afflicted with cancerous diseases, the bones sometimes become as brittle as if they had been calcined. Saviard and Louis relate cases of this description. (*Obs. Chir. et Journ. des Savans*, 1691. *Obs. et Remarques sur les Effets du Virus Cancereux*, Paris, 1750. *Pouteau, Œuvres Posthumes*, t. i.) Two remarkable instances of this kind were published by Mr. Salter of Poole. In the first, the patient, a female aged 82, felt the right thigh suddenly break as she was standing at her drawers. For several months previous to the accident, she had had constant and very severe pain in the part of the bone which was broken, and she had been long afflicted with a cancerous ulceration of the mamma. After death, the bone was so flexible, that no bony union could have taken place. A regular dissection of the limb was not allowed. In Mr. Salter's second case, the patient was also a female, 56 years of age, and, for five months preceding the accident, had laboured under violent pain of the right thigh, and a thickening of the periosteum a little above the patella. As her friends were putting her into a cart, the bone snapped about three inches below the trochanter. For several years she had had a scirrhus of the left breast. This had been removed, and the wound healed, but afterwards broke out in the form of cancerous ulceration. In this stage, the fracture took place, and was followed in about three months by her death. Mr. Salter removed the thigh-bone, and brought it home for examination; but, previously to its removal, the affected limb was observed to be considerably shorter than the other, and flexible at its middle, and a good deal deformed by a projection just below the trochanter major. The muscles of the thigh were pale and shrunk; a bloody fluid escaped from the capsular ligament of the knee-joint, and two or three clots of pure blood were in the articular cavity. On removing the patella, a small ulcer was discovered in the upper and external part of its articular surface. The thigh-bone was remarkably soft throughout its whole length, and the knife could be pushed through it at any part, but, at its middle, it was most conspicuously deficient in earthy matter. At about three inches from either extremity, it could be bent in any direction; and it was on the upper part of this portion that the fracture had taken place; but the precise situation of it was not distinctly visible, and Mr. Salter conceives, that there had been no complete separation, like what occurs in common fractures. The distortion did not arise from any overlapping, but from a bending of the bone. The muscles about the upper part of the limb were confounded together into an uniform mass of a pale red colour, firm and cartilaginous, with bony spiculæ thickly dispersed through them, and puriform matter slightly tinged with blood issuing from the cut surfaces. The integuments had suffered no change. In the situation of the swelling noticed above the patella, the tendon of the cruralis was much thickened and altered in texture, and a considerable quantity of pus came from under it; the subjacent periosteum was also much thickened, and readily detached. The parietes of the bone were here nearly absorbed, and the medullary cavity was filled with a bloody pultaceous substance. (See *Med. Chir. Trans.* vol. xv. p. 186.) It is justly inferred by Mr. Salter, that, as these cases corresponded in so many points, the predisposing cause of fracture was probably the same in both. Both the patients laboured under cancer of the breast; and both suffered much from previous pain and lameness. These cases, it is to be remarked, were rather specimens of mollities ossium, or preternatural flexibility of the bones affected; and seem to have differed from some examples of fragility on record, not only in their cause, but in the circumstance of no attempt at ossification having taken place in the broken or flexible parts. They resemble, in some respects, Mr. Howship's case; yet differ in the affection being restricted to one bone, and being the sequel of a cancerous disease of the breast. In University College Hospital, I remember a woman who had long laboured under cancer of the breast, and in whom several spontaneous fractures had occurred at different periods. She was treated in this hospital, first, for a fracture of the humerus, and afterwards for one of the clavicle. In this case, every fracture ultimately united.

M. Louis mentions a nun who broke her arm by merely leaning on a servant; and in the *London Medical Journal* an account is given of a person, who could not even turn in bed, without breaking some of his bones. One of Professor Gibson's patients, residing near Trenton in the United States, has a son, 19 years of age, who from infancy has been subject to fractures from the slightest causes, owing to an extraordinary brittleness of the bones. "The bones of the arm, fore-arm, thigh, and leg, have all been broken repeatedly, even from so trivial an accident as catching the foot in a fold of carpet whilst walking across the room. The clavicles have suffered more than any other bone, having been fractured eight times. What is remarkable, the boy has always enjoyed excellent health, and the bones have united without difficulty or much deformity." (*Institutes, &c. of Surgery*, vol. i. p. 370.)

Similar cases are mentioned by Mr. B. Bell. A child, he observes, fractures a limb. The fracture unites, and is consolidated perhaps in less than the usual period. Some time afterwards, on lifting a moderate weight, or on giving the limb a slight twist, it is again broken, and again unites. Mr. Bell saw this occur three times in different parts of the right humerus of a child five years of age, within the short period of eighteen months. "Several similar cases," he says, "have been under my care: in all of them, the patients seemed to enjoy robust health, were apparently untainted by scrofula, and their fragile bones united in a shorter space of time, than I have generally observed to be the case in individuals whose bones were tougher." (*On Diseases of Bones*, p. 71.) The same author has been able to discern in only two cases of fragility a palpable deviation from the healthy structure of the bones affected. The subject of one case was a gentleman at the middle period of life, who fractured his humerus in unscrewing a music-stool. The fracture was comminuted, and did not unite. The arm was at length amputated by Mr. George Bell at the shoulder. On examining the limb, the muscles around the fractured bone were found in a pulpy state. The bone, surrounded with blood, partly fluid and partly coagulated, was almost friable, and its whole surface perforated by innumerable, small, irregularly shaped holes, giving it a reticulated appearance. (*Op.* cit. p. 72.)

In the latter stages of syphilis, the bones sometimes become remarkably brittle. (*Ephem. Nat. Cur.* dec. ii. ann. iii. obs. 112. *Walther, Museum Anat.* t. ii. p. 29.)

In bad cases of scurvy, the bones are occasionally so brittle, that they are broken by the slightest cause, and do not grow together again. (*Boettcher von den Krankh. der Knochen*, p. 68.) In the museum of University College is a specimen of fragility from scrofula; the humerus having broken in two places from merely shampooing the limb.

Dr. Good was once present at a church, in which a lady, nearly seventy-two years old, broke both the thigh-bones by merely kneeling down; and, on being taken hold of to be carried away, had an os humeri also broken, without any violence, and with little pain. Hardly any constitutional disturbance ensued, and in a few weeks the bones united. (*Study of Medicine*, vol. v. p. 332. ed. 3.)

The fragilitas ossium of old age is incurable: but, in children, the tendency depends on some other constitutional disease, and can only be cured by a removal of the latter. (See *Boyer on Diseases of the Bones*, vol. ii.)

For additional remarks on brittleness of bones, see FRACTURE.

Consult *Waldshmidt*, Dis. de Fracturâ Ossium sine Causâ violentâ externâ. Kilon. 1721. *Acrel*, Chir. Vorfälle, b. ii. p. 136. *Courtial*, Nouvelles Obs. Anat. sur les Os, p. 64. 12mo. Paris, 1705. *Marcellus Donatus*, lib. v. c. i. p. 528. *Walther*, Museum Anat. vol. ii. p. 29. *Schmucker*, Vermischte Schriften, b. i. p. 385. *Kentish*, in Edin. Med. Comment. vol. i. Hist. de l'Acad. des Sciences, 1765. p. 65. Hist. de la Soc. Royale de Médecine, 1777 and 1778. p. 224. Journ. de Méd. t. lxxvii. p. 267.; t. lxxxiv. p. 216. *Isenflamm*, Pract. Bemerk. über Knochen, pp. 363. 415. 466. *Fabricius Hildanus*, cent. ii. obs. 66, 67, 68.; cent. v. obs. 89. *D'Aubenton*, Description du Cabinet du Roi, t. iii. *Meckren*, Obs. Med. Chir. p. 341. Amst. 1682. *Weidmann*, de Necrosi Ossium, p. 2. Francofurti, 1793; and the writings of *Duverney*, *Petit*, and *Pringle*. *Gooch*'s Obs. Appendix. *J. Wilson*, on the Skeleton, &c. p. 258. 8vo. Lond. 1820. *Gibson*'s Institutes of Surgery, vol. i. p. 370.; and vol. ii. p. 70. Philadelphia, 1825. *B. Bell*, on Diseases of the Bones, p. 71. Edin. 1828. *Salter*, in Med. Chir. Trans. vol. xv. *Howship*, in Edin. Med. Chir. Trans. vol. ii. *Herbert Mayo*, Outlines of Human Pathology, p. 18. 8vo. Lond. 1835.

FUNGUS. Any sponge-like excrescence. Granulations are often called *fungous*, when they are too high, large, and unhealthy.

FUNGUS HÆMATODES. (From *fungus*, and, *αἷμα*, blood.) So named by Hey. *Miltlike Tumour;* Monro. *Spongoid Inflammation;* Burns. *Soft Cancer;* Auct. Var. *Medullary Sarcoma;* Abernethy. *Fungoid Disease;* Sir. A. Cooper. *Matiére Encéphaloide,* ou *Cérébriforme;* Laennec. *Fungus Medullaris;* Maunoir. *Cephaloma;* Carswell.

This disease, accurately described only of late years, was formerly generally confounded with cancer. The public are indebted to J. Burns, of Glasgow, for the first interesting account of it: and the subsequent writings of Hey, Freer, Laennec, Andral, Carswell, Wardrop, Langstaff, and others, have made us still better acquainted with the subject.

It is unquestionably one of the most alarming diseases incidental to the human body, because we know of no specific remedy for it; and an operation can only be useful (if it can be useful at all) at a time when it is very difficult to persuade a patient to submit to it. Indeed, when the diseased part is within reach of operation, and extirpated at an early period, a recovery hardly ever follows; for, experience proves, that it is not a disease of a local nature, but almost always extends to a variety of organs and structures at the same time, either to the brain, the liver, or lungs, &c. It is of the utmost consequence to be aware of this fact, since we should otherwise be induced to attempt many hopeless operations, and deliver a prognosis that might cause disappointment and censure. In a large proportion of patients, afflicted with fungus hæmatodes, the general disorder of the system is indicated by a peculiarly unhealthy aspect; a sallow, greenish yellow colour of the skin, which is frequently covered with clammy perspiration; constant troublesome cough; difficulty of breathing, &c.

Fungus Hæmatodes was the name introduced by Hey. J. Burns has called the disease *spongoid inflammation*, from the spongy elastic feel which peculiarly characterizes it, and which continues even after ulceration has taken place. The expression, fungus hæmatodes, is by no means an eligible one; because the disease is not always followed by a protrusion of a bleeding mass; never until the disease has reached an advanced stage; and then the substance, which projects, is not truly a fungus, but the medullary matter itself.

If, with Dr. Carswell, we regard fungus hæmatodes as a species of carcinoma, then we may comprehend the disease under his general definition of the latter, as consisting in the formation or deposition of a peculiar substance, which presents great variety of consistence, form, and colour; possesses a vascular organization of its own; gives rise to the gradual destruction, or transformation of tissues; affects successively or simultaneously a greater or less number of organs; and has a remarkable reproductive tendency. Dr. Kerr defines fungus hæmatodes, "as a morbid condition of the body, evinced by the development of an elastic uneven tumour, or tumours, not painful in their early stage, and becoming so only by implication with surrounding parts; tending to ulceration; and by ulceration presenting to view a soft and spongy fungus, rapid in its growth, readily bleeding in vascular textures, and emitting a peculiar serous discharge, of a very fetid odour, more or less coloured with blood." (*Cyclop. of Pract. Med.* art. *Fungus Hæmatodes.*) As I have already observed, however, the protrusion is not a fungus, nor is its structure truly spongy; the disposition to hæmorrhage, likewise, depends, as Dr. Carswell has pointed out, less upon the vascularity of the surrounding parts, than upon its own vascularity, and the thinness of the coats of its bloodvessels.

The consistence of fungus hæmatodes, or medullary sarcoma, varies in different cases, and sometimes at different points of the same tumour; being sometimes more dense than brain, or even as compact as boiled udder, while, in other instances, its softness is equal to that of the fœtal brain, or the milt of a fish; neither is the colour always the same in every case; and it is frequently different at various points of the same mass. Generally, it is like that of the medullary substance of the brain; but sometimes it is redder in particular places, or the medullary matter is broken down and blended with blood, and there may then be within the swelling clots of blood. It was the doctrine of Laennec, that the soft consistence of all carcinomatous formations is invariably preceded by a hard condition, of them. This opinion is not entirely renounced at the present time, though the investigations of M. Andral and Dr. Carswell clearly prove that it ought to be so. "The carcinomatous deposit, besides being modified in its consistence by the tissues in which it is contained, is equally so in consequence of a difference in its composition: it may be either hard or soft at this period; and consequently the latter state is not necessarily preceded by the former." (See *Illustrations of the Elem. Forms of Disease,* fasc. iii.) Dr. Carswell illustrates this fact by reference to what happens in the cellular tissue and on serous surfaces; and more especially on the surfaces of sores, formed by the destruction of protruded portions of tumours, or after the removal of the breast, eye, or testis, affected with carcinoma. In all these situations, he observes, the deposited substance may present, at the same stage of its formation, the opposite extremes of consistence; being in one case as hard as cartilage, and more or less transparent, and in another, as soft as brain, and quite fluid, and opaque.

One very important pathological fact, in relation to this subject, is the frequency of scirrhus, medullary sarcoma, and fungus hæmatodes, originating in the same morbid state, and passing from one to the other in this order, as specified by Dr. Carswell. Indeed, he adds, we often meet with all the varieties of scirrhus and medullary cancer (termed by him cephaloma), not only in different organs of the same individual, but even in a single organ. I have now seen many cases, proving the truth of these statements; yet, probably, the doctrine is correct, which represents fungus hæmatodes as a distinct malady, "although it may be consequent upon, or complicated with, other alterations of structure. When it occurs in *young* subjects, it is always *primary*, or is not preceded nor attended by the carcinomatous formation. But in persons past the meridian of life, in whom only scirrho-cancer, or cancer, is met with, the fungoid structure is sometimes produced *consecutively*, or, in an advanced stage of it, and thus occasionally exists as a secondary complication with that disease, or as one of the advanced changes of structure, consequent upon the constitutional vice." (See *Dr. Copland's Dict. of Pract. Med.* art. *Fungoid Disease.*) The same writer adds that, in a few instances, other morbid formations, besides this, have been found associated with the cerebriform structure, as fibrous tumours, scrofulous matters, pus, melanosis, hydatids, and earthy deposits. Dupuytren notices a form of fungus hæmatodes, which is pulsatory, and combined with erectile tissue; which latter circumstance, he says, may render the disease susceptible of a favourable change by the ligature of the artery, whose branches keep up the circulation in it; while the other elementary matters, found in it in greater, or lesser quantity, as the scirrhous and cerebriform, are a great impediment to the success of this method of relief. (See *Clin. Chir.* t. iv. p. 59., and *Andral, Anat. Pathol.* t. i. p. 219.) The bloodvessels, which enter scirrhus and medullary sarcoma, vary greatly in number, and sometimes considerably in bulk. They are rarely perceptible in any of the varieties of scirrhus, and are but few in the organized and mammary sarcoma, which are considered by Dr. Carswell as varieties of medullary sarcoma (cephaloma); while, in ordinary medullary sarcoma, they are often so numerous, as to form the greater portion of the brain-like tumour, in which they ramify. In the latter disease, they are described by the latter eminent pathologist, as varying in diameter from the breadth of a hair to that of a line, and to present that peculiarity of distribution, always more or less conspicuous in newly formed bloodvessels, which is, that their ramifications communicate with a common trunk at its opposite extremities, in the same manner as the hepatic and abdominal divisions of the vena portæ do with the trunk of this vessel. They are frequently varicose; their coats are remarkably delicate, and they have altogether much more of a venous, than of an arterial, character. According to Dr. Carswell's researches, they appear to be formed apart from the vascular system of the surrounding textures, as they can be seen to originate in small red points, situated at the centre, or at the circumference of the carcinomatous mass, which first assume the appearance of slender streaks of blood, and afterwards acquire a cylindrical arrangement and ramiform distribution, thereby constituting what may be denominated the *proper circulation* of medullary sarcoma, or cephaloma. The communication between these vessels and those of the organ, in which the medullary substance is contained, is frequently very imperfect; a circumstance, which, together with the delicacy of their structure, renders them extremely liable to congestion and rupture. The most minute divisions of these vessels terminate by penicillated extremities in the carcinomatous matter, where they communicate with veins and arteries belonging to the affected organ. The latter vessels, which Dr. Carswell regards as forming what may be termed the *collateral circulation* of medullary sarcoma, are seldom so conspicuous as the former; though cases now and then occur in which they constitute the greater part of the vascular structure of the disease. They are described by the same excellent pathologist, as proceeding in a radiating direction from the pedunculated attachment of a tumour, or as arising along its circumference in the cellular tissue, separating it from the neighbouring parts. It is, he observes, by means of these vessels, that the materials required for the nutrition and growth of such tumours are supplied; and causes, interrupting this collateral circulation, will occasion the partial or compelte destruction of these and other tumours. (See *Carswell's Illustrations of the Elem. Forms of Disease*, fasc. iii.)

According to the same high authority, nerves have never been detected in this, or any other variety of cancer, as a *new formation*, though they are sometimes included within agglomerated tumours, or even a single tumour, that has happened to form in a situation though which they pass. In some cases, the nerves have participated in the change of structure; but, according to Dr. Copland, they have not been found changed beyond the limits of the tumour. In the eye, the structure of the optic nerve is constantly altered; and, in a case, referred to by Mr. Wardrop, the anterior crural nerve passed into the centre of the diseased mass, and was so completely lost in it, that it was impossible to distinguish one structure from the other. Observations of this kind led M. Maunoir to suppose, that the medullary matter was actually a collection of nervous pulp; an idea very inconsistent with the well known insensibility of such medullary matter. M. Lobstein, in combating the doctrine of M. Maunoir, declares, that he has seen cases, in the early stage of which the nerves passed through the tumour without undergoing any change.

A very common character of medullary tumours is to be lobular, the lobules being closely compacted together, and enclosed in remarkably fine cysts, the presence of which may be demonstrated by macerating the soft substance, and washing it away, or dissolving the medullary matter with the aid of alkalies. This lobulated and encysted structure, is generally noticed in cases where the tumour is near the surface of the body. These cysts, in which the medullary matter is often contained, are externally fibrous and cellular, but internally they present, as Dupuytren remarks, a completely serous organization, and here a serosity exhales from them. Sometimes the medullary matter originates from, and is adherent to, a single point of the cyst; while, in other instances, it adheres almost to every part of the interior of the cyst, which is itself closely connected to the surrounding textures. Under these circumstances, the cyst is fibro-cellular, or entirely fibrous. (See *Dupuytren, in Clin. Chir.* t. iv. p. 57.)

Dr. Hodgkin has advanced the doctrine, that the presence of a serous membrane, having a cystiform arrangement, is necessary for the production of cancerous and some other kinds of tumours. The existence of the cyst, he believes, precedes the formation of the morbid substance, and constitutes the seat and origin of the disease. (See *Med. Chir. Trans.* vol. xv.) Although Dr. Carswell admits, that this mode of origin is sometimes exemplified, he mentions facts, which leave no doubt, that it is only accidental, and not essential. Cysts, he observes, partake of the structure and functions of serous membrane, and consequently are subject to similar diseases. "If therefore such cysts should exist in an individual having the cancerous diathesis, they may, in the same manner as a natural serous membrane, become the seat of any variety of carcinoma. But, although carcinomatous tumours, such as those described by Dr. Hodgkin, are found contained in cysts, attached, single, or in groups, and covered by a reflected serous membrane, these tumours may, and frequently do, not originate in the cysts. They may form in the cellular tissue external to the cysts, and, during their development, project inwards, carrying before them, as their common envelop, the internal and serous lining of the latter. Such, in fact, is seen to be the origin of these tumours in most of the cysts, represented by Dr. Hodgkin in the work referred to. They are situated external to the cyst, are supplied with vessels which do not belong to it, and are placed in the same circumstances as tumours formed in the cellular tissue, when no cyst is present.

"As an objection to the general application of the cystic origin of tumours, it may be observed, that the presence of cysts in the liver, walls of the stomach, lungs, kidneys, brain, lymphatic glands, spleen, and blood, is not to be detected at any period of the development of carcinoma; and, therefore, when they do occur in other organs, as the ovaries, testes, mammæ, &c., they must be regarded as a mere coincidence, or as a consequence of the disease, and not as a cause, or necessary condition of it." (See *Carswell's Illustrations of the Elem. Forms of Disease*, fasc. ii.)

A very interesting fact, in relation to fungus hæmatodes, or medullary sarcoma, is that of the occasional presence of the cerebriform substance in the veins and absorbents. A similar fact is noticed with regard to scirrhous cancer. Dr. Carswell believes, that the carcinomatous and medullary matter is formed in the blood, whether met with in this fluid alone, or in other parts at the same time; and he supports his view upon the facts,—1st, That the morbid substance is found in the vessels, which ramify in these malignant tumours, or their vicinity. 2dly, That it is found in those vessels which communicate with the diseased parts of an organ. 3dly, That it is sometimes met with in vessels, having no direct communication with another part, that is the seat of the same disease. After noticing that the venous and capillary divisions of the vascular system are those, in which the carcinomatous substance has been observed, Dr. Carswell describes the forms under which it appears in the blood, and which are exceedingly various; "sometimes perfectly similar to those which mark its presence in the substance or on the surface of organs. In large veins, such as the vena portæ and its branches, the emulgent vein, &c., it may present the lardaceous, mammary, medullary, or hæmatoid characters, all in the same venous trunk. These varieties of the carcinomatous formation may be found mixed together in minute quantities, or isolated into masses so conspicuous, that we can readily distinguish them from one another. Sometimes, they lie merely in contact with the internal parietes of the vein; at other times, they are united to the latter by means of a thin layer of colourless fibrine; or minute blood vessels pass from the one into the other, and are often very numerous, and remarkably conspicuous in the cerebriform matter." It seems to Dr. Carswell, that the presence of an organized product in the blood can have no other origin, than the blood itself, and that such a product cannot be introduced into this fluid by absorption. (See *Illustrations of the Elem. Forms of Disease*, fasc. ii.)

By some pathologists, a different view is taken of this part of the subject, and they maintain, that, when the carcinomatous or medullary matter is found in the blood, it has been absorbed. On this principle, the extension of the disease is even attempted to be in part accounted for. But, the frequently organized state of the product in the blood, and its occasional existence there without any traces of a similar formation in any other part of the system, are arguments strongly confirming the accuracy of Dr. Carswell's statements. This gentleman's doctrine is not, however, universally adopted. Thus, Dr. Copland observes that the formation of the cerebriform matter in the blood, and its subsequent deposit in the parts, which are its seats, "cannot be supported by the history and progress of the local and constitutional affections. If it were previously formed in the blood, wherefore is it often deposited only in one situation? Wherefore is it not excreted by the emunctories? Wherefore does it not always affect a number of parts simultaneously? Wherefore is it never found in the arteries, and so frequently in the absorbents and veins procceding from the seat of the disease?" These and other questions, Dr. Copland maintains, cannot be answered consistently with Dr. Carswell's doctrine. (See *Dict. of Pract. Méd.* art. *Fungoid Disease.*) With respect to the medullary substance never being met with in the arteries, Mr. Hey states, that in a case of fungus hæmatodes of the thigh, "the femoral artery was filled with matter, resembling stiff coagulated blood, which prevented the blood from flowing through the divided vessel."

According to the researches of Lobstein, the firmer the tumour, and the earlier the stage of it, the greater the proportion of gelatine to the albumen in it. On the other hand, when the morbid substance is of the consistence of soft brain, the albumen in it is in much greater quantity than the gelatine. I have already explained, however, that the firm and soft conditions of the disease are, by no means, any certain proof of its early and advanced stages, since the morbid substance is frequently from the first of the same consistence, which it exhibits in the end.

Fungus hæmatodes, or medullary cancer, is much more frequently met with in young, than old persons; children of the most tender years being often its victims. I am not aware of any records, by which a judgment might be formed of the comparative frequency of the disease in the two sexes. In my practice, more instances of it, in external situations, have presented themselves in males, than females. The testis, as is universally acknowledged, is oftener the seat of it, than the mamma. Speaking of it, however, more generally, I can offer no opinion of its comparative frequency in the two sexes. Dr. Kerr leans to the supposition, that females are more frequently the subjects of it than males. (See *Cyclop. of Pract. Med.* art. *Fungus Hæmatodes.*)

It is a common remark, that the persons, whom it attacks, are generally of a sallow complexion, lax fibre, and weak circulation. Yet, when the disease is in the early stage, and limited to some external situation, as, for instance, to one of the limbs, there may be no other apparent fault in the health; and the patient may be neither sallow, nor debilitated. A fine, stout, healthy looking lad was brought a few months ago to University College Hospital, who had a medullary tumour, as large as an orange, upon the lower border of the latissimus dorsi. The same case exemplified also one character of medullary tumours, meriting particular notice, viz. the extraordinary rapidity with which they sometimes increase, even though the skin may not have ulcerated. In this boy, the tumour, which I have mentioned, enlarged so much in the course of a week, that it not only extended completely across the axilla, but far up into its cavity. But the progress of the disease is not always quick; and at one time it may be very slow, and at other periods surprisingly rapid. Generally, when it is liberated from a part of its coverings by ulceration, or when it returns in a part, in which an attempt has been made to extirpate it by operation, the growth of the protruding medullary mass is very quick.

Fungus hæmatodes has frequently attacked the eyeball, the upper and lower extremities, the testicle, and the mamma. But the uterus, ovary, liver, spleen, brain, lungs, thyroid gland, hip and shoulder joints, and various other parts and organs, may be seats of the disease.

It is in this medullary form of disease, that a vascular organization is most conspicuous; and as the coats of the vessels, with which it is supplied, are remarkably delicate, the circulation of the blood though them is readily interrupted; hæmorrhage from congestive rupture takes place; and the effused blood is mixed in less or greater quantity with the brain-like matter. (See *R. Carswell's Illustrations of the Elem. Forms of Disease,* fasc. ii.) The appearances thus produced, are termed hæmatoid. By M. Roux, Dr. Carswell, and all writers who employ the expression *soft cancer*, fungus hæmatodes, or medullary sarcoma, is regarded, either as closely allied to cancer, or as actually a variety of it. Under the generic term of carcinoma, indeed, Dr. Carswell comprehends scirrhus; the common vascular or organized sarcoma of Abernethy; also his pancreatic, mammary, and medullary sarcoma; and fungus hæmatodes, or the latter disease in an advanced stage, with a portion of the mass of the disease protruding. Dr. Carswell's reasons for this classification are:—1st, That all these diseases "often present in the early periods of their formation, certain characters common to all of them. 2dly, They all terminate in the gradual destruction, or transformation, of the tissues which they affect. 3dly, They have all a tendency to affect several organs in the same individual. 4thly, They all possess, although in various degrees, the same reproductive character." When medullary cancer is not of immoderate size, and situated directly under the integuments, its surface is generally at first smooth, but after a time uneven, or lobulated; the colour of the skin not altered; the part has a soft elastic feel; and it seems as if an indistinct fluctuation were perceived in it.

Fungus Hæmatodes of the Limbs.

In the extremities, the disease begins with a small colourless tumour, which is soft and elastic, if there be no thick covering over it, such as a fascia: but, otherwise, it is tense. At first, it is free from uneasiness; but, by degrees, a severe acute pain darts occasionally through it, more and more frequently, and, at length, becomes incessant. For a considerable time, the tumour is smooth and even; but, afterwards, it projects irregularly at one or more points; and the skin at these places becomes of a livid red colour, and feels thinner. In this situation, it easily yields to pressure, but instantly bounds up again. Small openings now form in these projections, through which is discharged a thin bloody matter. Almost immediately after these tumours burst, a small fungus protrudes, like a papilla, and this rapidly increases, both in breadth and height, and has exactly the appearance of a carcinomatous fungus, and frequently bleeds profusely. The matter is thin, and exceedingly fetid, and the pain becomes of the smarting kind. The integuments, for a little way round these ulcers, are red, and tender. After ulceration takes place, the neighbouring glands swell, and assume exactly the spongy qualities of the primary tumour. If the patient still survive the disease in its present advanced progress, similar tumours form in other parts of the body, and the patient dies hectic.

After death, or amputation, the tumour is found to consist of a soft substance, somewhat like the brain, of a greyish colour, and greasy appearance, with thin membrane-like divisions running through it, and cells, or abscesses, in different places, containing a thin bloody matter, occasionally in very considerable quantity. There does not seem uniformly to be any entire cyst, surrounding the tumour; for, it very frequently dives down betwixt the muscles, or down to the bone, to which it often appears to adhere. The neighbouring muscles are of a pale colour, and lose their fibrous appearance, becoming more like liver than muscle. The bones are mostly carious in the vicinity of the disease.

The growth of medullary tumours near the surface of the body, is sometimes preceded by a blow on the part; but, in general, the exciting cause is perfectly obscure, the disease appearing to begin spontaneously, though in connection with some unknown peculiarity, or modification of the constitution, without which, no circumstances would be capable of inducing it: when we see a patient sallow and enfeebled in this disease, such change of the complexion, and the debility manifested, are not to be regarded as causes, but only as effects of the disease on the general health. (*J. Burns on Inflammation*, vol. ii.)

Mr. Hey recorded several cases of fungus hæmatodes. If I notice the principal circumstances relative to one of these, they will suffice to inform the reader of the form in which this terrible affliction presented itself in this gentleman's practice.

A young man, aged twenty-one, two years before, applying to Mr. Hey, perceived a small swelling on the inside of the right knee, not far from the patella. This tumour was moveable, and did not impede the motion of the joint: it was not discoloured, but was painful when moved or pressed upon. It continued in this state half a year; and then, the man having hurt his knee against a stone, it gradually increased in bulk, but did not exceed the size of an egg. The skin was now discoloured with blue specks, which were taken to be veins. He could still walk with ease, and follow his business.

Two months before his admission into the Leeds Infirmary, he met with a fall, and violently bent his knee, but did not strike it against any thing. The tumour began immediately to enlarge; and, within a few hours it extended half way up the inside of the thigh. About a fortnight after this accident, the skin burst at the lowest part of the tumour, and discharged some blood. A dark-coloured fungus, about the size of a pigeon's egg, here made its appearance; and, a few weeks afterwards, the skin burst at another part of the large tumour, and some blood was again discharged. From the fissure arose another fungus, which had increased, in the course of the last week, to the size of a small melon, and now measured eight inches from one side of its base to the other. The base of the fungus frequently bled, especially when the man allowed his limb to hang down.

The whole tumour was now of an enormous size, being nineteen inches across, when the measure was carried over the last-mentioned fungus. From its highest part in the thigh to the lowest part, just below the knee, it measured seventeen inches, without including the fungus. The base of the tumour at the knee, exclusive of that part which ran up the thigh, measured twenty-four inches in circumference. The tumour was situated on the inner side of the limb, and was distinctly defined. The skin, covering the disease, was in some places livid, and had several fissures and small ulcerations upon it; but had not burst asunder, except in the two places above described. The tumour was soft, and gave a sensation of some contained fluid, when gently pressed with the hands alternately in opposite directions. The patient said he had walked without pain in his knee, a week before his admission into the infirmary; and he had lost very little blood in his journey to Leeds. He complained of the greatest uneasiness in the highest part of the tumour. It had become hot and painful in the night-time, for some days past. His pulse was 114 in a minute; his tongue was clean; and his appetite had been good, till the last few days. He had never felt any pulsation in the tumour.

In a consultation it was determined, that the tumour should be laid open, by cutting off a portion of the distended integuments; and that, after removing the contents, if the sac should be found in a sound state, the disease should be treated as a simple wound; but if in a morbid state, amputation of the limb should be immediately performed.

A large oval piece of the integuments being removed, the tumour was found to contain a very large quantity of a substance not much unlike coagulated blood, but more nearly resembling the medullary part of the brain in its consistence and oily nature. It was of a variegated reddish colour, in some parts approaching to white, and, as blood issued from it, Mr. Hey conceived it was organized. This mass was partly diffused through the circumjacent parts in innumerable pouches, to which it adhered, and was partly contained in a large sac of an aponeurotic texture, which was connected with the capsule of the knee-joint. There was a great and universal effusion of blood from the internal surface of the sac, and from the pouches containing this morbid mass.

Amputation of the limb was immediately performed, on finding such to be the nature of the case. Mr. Hey, unfortunately however, left a portion of the diseased surface behind on the inner part of the thigh, and hoping that a small narrow portion of the upper part of the sac would soon become a clean sore, and not impede the cure, he made the circular incision two inches below its higher part.

On examining the amputated limb, the vastus internus was found to be brown, and much softer than the other muscles, which were healthy. There were many small portions of blood extravasated in the substance of this muscle. The sac was formed on the aponeurotic covering of the muscle, and ended below where this aponeurosis begins to cover the capsular ligament of the knee. The two fungous substances, above described, appeared to have been only extensions of the morbid mass, where this had made its way through the sac and the integuments. The joint of the knee, and muscles of the leg, were perfectly sound.

I need not detail all the particulars after the operation. Suffice it to say, the man suffered a great deal of constitutional disorder. After a few weeks, the granulations upon the stump became good, and the cicatrization was nearly completed at the end of the sixth week after the amputation. At this period, the small and superficial portion of the upper part of the great sac, which Mr. Hey had unfortunately left, was now healed; but a tumour, now about four inches in length, and between two and three in breadth, had gradually risen at the lower and under part of the thigh, beneath the cicatrix. This contained a soft substance, exactly similar, as far as the touch could discover, to that which had filled the large sac. This tumour became painful, and sometimes discharged a bloody serum, sometimes dark-coloured blood, through four or five small openings in the cicatrix.

Mr. Hey laid open the tumour, and removed its contents; but no advantage was gained by this proceeding. The interior surface was found to be too much diseased to produce good granulations. Blood continued to ooze out of the wound for a few days. Then the inner surface became covered with a blackish substance, which gradually extended itself, and formed a new fungus. A variety of escharotics were applied to destroy the fungous and morbid surface of the wound, but to no purpose; the growth of the fungus always exceeded the quantity destroyed. Undiluted sulphuric acid, applied freely, had very little effect.

An attempt was once more made to cut away the disease; but, on examining the wound carefully, after the contained substance was removed, the muscular substance was found degenerated into a hard mass, which felt somewhat like cartilage. The adipose membrane was also diseased, and formed into large cells, which had contained the fungous substance. Hence, another amputation seemed the only resource.

After this operation the whole surface of the stump seemed sound, except the principal artery, which was filled with a somewhat stiff matter, resembling coagulated blood, which prevented its bleeding. The inside of the vessel, on being touched with the scalpel, felt hard, and communicated a sensation like that of scraping bone.

The man was sent home as soon as his state would admit of it; but he died consumptive about six months afterwards. Besides this instance, in the thigh, Mr. Hey relates cases of fungus hæmatodes, situated in the female breast, in the leg, in the neck (extending from the jaw to the clavicle, and producing suffocation), on the back part of the neck, on the back part of the shoulder, and at the extremity of the fore-arm, near the wrist.

"If I do not mistake (says Mr. Hey), this disease not unfrequently affects the globe of the eye, causing an enlargement of it, with the destruction of its internal organization. If the eye is not extirpated, the sclerotis bursts at the last, a bloody sanious matter is discharged, and the patient sinks under the complaint." (p. 283.)

Besides some cases, in similar situations, to those mentioned by Mr. Hey, one is related by Mr. Burns, in which the hip-joint was the seat of this terrible affection. After detailing the progress of the case to the poor man's death, this author states, that he found, on dissection, the hip-joint completely surrounded with a soft matter, resembling the brain, enclosed in thin cells, and here and there cells full of thin bloody water: the head of the thigh-bone was quite carious, as was also the acetabulum. The muscles were very pale, and almost like boiled liver, having completely lost their fibrous appearance, and muscular properties. The same sort of morbid mischief was also found within the pelvis, most of the inside of the bones on the affected side being carious. An attempt had been made, before the patient died, to tap the bladder; but, the trocar had only entered a cell filled with bloody water, and situated in a mass of the soft brain-like substance.

I have already stated enough in explanation of the dreadful nature of fungus hæmatodes. Little can be said of the treatment; for, we know not of one medicine that seems to have the least power of putting a stop to the disease, which, when left to itself, has always proved fatal, with the exception of the rare cures by mortification of the parts, as illustrated in one example, related by Schmidt, where a medullary tumour of the eye mortified, the sloughs were detached, the eyeball collapsed, and a small knob, consisting almost entirely of the contracted sclerotica, was the only remnant of this dreadful form of disease. A case of fungus hæmatodes of the left cheek is alleged, by Dr. Schutte, to have terminated favourably by the process of mortification and sloughing. (See *Grafe's Journ.*) Under Mr. Cline, there was a woman whose breast healed up after the diseased mass had been thrown off by sloughing. (*Lancet*, vol. ii. p. 401.) With a few exceptions of this kind, we have no reason to believe that there is the smallest chance of any spontaneous amendment, much less of a cure. Also, in some of the cases just now cited, it is not known whether any relapse followed.

We have seen that, when the chief part of a fungus hæmatodes is cut away, and only a small portion of its cyst left behind, the fungus is reproduced from this part, and soon becomes as formidable, nay, more formidable, than it was before, and this, notwithstanding the application of the most powerful escharotics. Neither the hydrargyrus nitratus ruber, the hydrargyrus muriatus, the antimonium muriatum, nor the undiluted sulphuric acid, has always been able to repress the growth of such fungus. (*Hey.*)

No known remedy has the power of checking or removing the complaint. Friction, with anodyne liniments, sometimes gives relief in the early stages; but it does not retard the progress of the disease. Mercury and iodine have been alleged to do so, but I have never seen an instance of it.

In short, the only chance of cure consists in extirpating the whole of the distempered parts, removing not only the soft, brain-like, fungous substance, but every particle of the cysts, sacs, or pouches, in which it may be contained. The result of such proceedings is also for the most part unsuccessful, the disease returning in the same situation, or manifesting itself soon afterwards in others. Experience proclaims this discouraging truth so loudly, that many of the best surgeons now decline to undertake any operation in cases of this description; for, if the attempt fails, the patient is put to unnecessary pain, and his life is abridged by the more rapid and deplorable form in which the disease reappears. At all events, an operation is justifiable only in the early stages, while the disease is entirely local, if it ever be so, — a circumstance much to be doubted. After the neighbouring glands have become affected, all chance of recovery is destroyed. Nor should the knife be resorted to for the removal of any external medullary tumour, when there is any sign of the existence of other tumours of the same nature in any of the viscera, glands, or other deep-seated organs. It is sometimes difficult to persuade patients, at an early period, to submit to amputation, or extirpation, because the pain and inconveniences are considerable; but if circumstances then warrant the performance of the operation, it should be urged with all the force, which a conviction of its absolute necessity, and the fatal peril of delay, ought to inspire.

The attempts to cure a medullary tumour on a limb by cutting it away have been attended with such ill success, that many surgeons deem it advisable not to follow this method, but to amputate the limb at once. The annexed views of the matter appear to me to be most judicious and rational. First, that if an attempt be made to cut away the tumour, and save the limb, the surgeon must be careful to remove, at the same time, a considerable quantity of the soft parts in the circumference of the swelling. Secondly, that the earlier this is done, the more likely is it to succeed. Thirdly, that after the tumour has been taken out, an attentive examination of the surface of the wound should be made, and every suspicious part, or fibre, be cut away. Fourthly, that, should the disease still recur, amputation ought to be instantly performed. Fifthly, that caustics should never be applied to this disease. Sixthly, that, even when one of these operations effectually extirpates the distemper in the limb itself, the patient's entire recovery is always rendered exceedingly uncertain, by reason of the viscera, and other deep-seated parts, being frequently affected at the time of the operation, with the same sort of disease, which state of them, though invisible, is often denoted by a sallow complexion, debility, indigestion, emaciation, and hectic.

I will quit this part of the subject with stating some of the principal differences between this form of malignant disease and scirrhus. A scirrhous tumour is, from its commencement, hard, firm, and incompressible, and is composed of two substances; one hardened and fibrous, the other soft and inorganic. The fibrous matter is the most abundant, consisting of septa, which are paler than the soft substance between them. A scirrhous tumour situated in a gland, is not capable of being separated from the latter part, so much are the two structures blended. A scirrhus, in another situation, sometimes condenses the surrounding cellular substance, so as to form a kind of capsule, and assume a circumscribed appearance. When a scirrhous swelling ulcerates, a thin ichor is discharged, and a good deal of the hard fibrous substance is destroyed by the ulceration; other parts become affected, and the patient dies from the increased ravages of the disease, and its irritation on the constitution. Sometimes, though not always, after a scirrhus has ulcerated, it emits a fungus of a very hard texture. Such excresence, however, is itself at last destroyed by the ulceration. Cancerous sores, also, frequently put on for a short time, in some places, an appearance of cicatrization. On the other hand, fungus hæmatodes, while of moderate size, is a soft elastic swelling, with an equal surface, and a deceitful feel of fluctuation. It is, in general, quite circumscribed, being included within a capsule. The substance of the tumour, instead of being for the most part hard, consists of a soft, pulpy, medullary matter, which readily mixes with water. When ulceration occurs, the tumour is not lessened by this process, as in scirrhus; but a fungus is emitted, and the whole swelling grows with increased rapidity. Cancerous diseases are mostly met with in persons above forty years of age, while fungus hæmatodes generally afflicts young subjects. (*Wardrop.*) Many dissections have now proved, that the substance of fungus hæmatodes may contain cellular septa, which include the pulpy, medullary matter.

Fungus hæmatodes, in its early stage, is generally attended with less acute pain than what is experienced in cases of scirrhus. The tumour also has a less definite boundary than a scirrhus, and it is more difficult to say, where the diseased structure terminates, and where the healthy commences. When the disease is in the breast, there is less tendency, than in scirrhous cases, to disease in the axillary glands, which may remain sound, though the disorder in the breast may have advanced to suppuration and ulceration. In the breast, the disease is also much quicker in its progress, than scirrhus. (*Sir A. Cooper, Lancet*, vol. ii. p. 399.)

In cases of external cancer, the viscera are not in general affected at the same time with cancerous disease; but in the majority of examples of fungus hæmatodes, this distemper is found affecting in the same subject a variety of parts. In addition to the outward tumour, we find swellings of a similar nature, perhaps, in the liver, the lungs, the mesenteric glands, or even in the brain.

Fungus Hæmatodes of the Eye

Presents three stages. In the first, the exterior form of the eye is unchanged, and the disease is perceived through the cornea and pupil. In the second, the form of the eye is altered; the organ is enlarged, and its tunics are ready to give way. In the third (or *fungous* stage), the eye has burst, and the tumour protrudes. (See *Mackenzie on Dis. of the Eye*, p. 647. ed. 2.)

The first symptoms are observable in the posterior chamber, an appearance like that of polished iron presenting itself at the bottom of the eye. (*Scarpa on Diseases of the Eye*, p. 505. ed. 2.) The pupil becomes dilated and immoveable, and, instead of having its natural deep black colour, it is of a dark amber, and sometimes of a greenish hue. The change of colour becomes gradually more and more remarkable, and at length is discovered to be occasioned by a solid substance, which proceeds from the bottom of the eye towards the cornea. The surface of this substance is generally rugged and unequal, and ramifications of the central artery of the retina may sometimes be seen running across it. The front surface of the new mass at length advances as far forwards as the iris, and the amber, or brown appearance of the pupil, has, in this stage, been known to mislead surgeons into the supposition of there being a cataract, and cause them to attempt couching. The disease continuing to increase, the eyeball loses its natural figure, and assumes an irregular knobby appearance. The sclerotica also loses its white colour, and becomes of a dark blue, or livid hue. Sometimes matter now collects between the tumour and the cornea. The latter membrane in time ulcerates, and the diseased mass begins to protrude. In a few instances, it makes its way through the sclerotica, and is then covered by the conjunctiva. The surface of the excrescence is irregular, often covered with coagulated blood, and bleeds profusely from slight causes. When the fungus is very large, the most prominent parts slough away, attended with a fetid sanious discharge. In the course of the disease, the absorbent glands, under the jaw, and about the parotid gland, may become contaminated. On dissection, a diseased mass is found extending forwards from the entrance of the optic nerve, the vitreous, crystalline, and aqueous humours being absorbed. The retina is annihilated, and the choroid coat propelled forwards, or quite destroyed. The tumour seems to consist of a sort of medullary matter, resembling brain. The optic nerve is thicker and harder than natural, of a brownish ash-colour, and destitute of its usual tubular appearance. In other cases, the nerve is split into two or more pieces, the interspaces being filled up with the morbid growth. (*Wardrop.*) Nay, as Mr. Travers has stated, the optic ganglion, tractus opticus, and thalamus, have been repeatedly found diseased, and the surrounding adipose substance in the orbit affected to a considerable extent in places also where there was no direct communication with the diseased contents of the globe. (*Synopsis of the Diseases of the Eye*, p. 221.) Even the brain has been observed to share in the disease, sometimes dark-red spots appearing on the dura mater; sometimes small spots, containing a fluid like cream, being found between the pia mater and tunica arachnoides. Mr. Travers has a preparation, exhibiting a genuine example of the disease affecting the anterior right lobe of the cerebrum, and protruding the eye from its socket, while the eye itself was perfectly free from disease. (*Op.* cit. p. 223.) When the lymphatic glands at the angle of the jaw are enlarged, as they frequently are, they are also found converted into a kind of medullary matter, similar to that which composes the diseased mass in the eyeball. When the skin bursts over a diseased absorbent gland, a sloughy ulcer is produced; but no fungus is emitted, unless the affection of the gland with fungus hæmatodes be primary. In University College Hospital, a poor Irishman was under my care in the autumn of 1836, who had a large medullary tumour, covering all the submaxillary region, and which, probably, at first, had been merely an absorbent gland. In this case, after ulceration of the skin, protrusion of the medullary substance, and sloughing of it, a thin fetid discharge, occasional hæmorrhage, and extreme emaciation and weakness, preceded the patient's death.

Fungus hæmatodes of the eye was formerly not discriminated from scirrhous cancer. We learn from Bichat, that more than one third of the patients on whom Desault operated for *supposed* carcinoma of the eye were under twelve years of age. Twenty out of twenty-four cases of fungus hæmatodes of the eye, with which Mr. Wardrop has been acquainted, happened to children under twelve years of age. Now, as cancer is rather a disease of aged than young persons, and we find, from Mr. Wardrop, that fungus hæmatodes of the eye mostly affects persons under twelve years of age, it is tolerably certain, that most of Desault's cases, reported to be cancers of the eye, were in fact the equally terrible disease now engaging our consideration. It is observed by Dr. Mackenzie, that the greatest number of cases has been observed in children from two to four years of age. Sometimes the disease occurs a few months after birth. In one instance, he saw it in an infant only nine weeks old, and the mother had noticed it six weeks earlier, so that the disease was probably congenital. On the other hand, it has been known to attack adults, or even persons of advanced age. (See *Mackenzie on Dis. of the Eye*, p. 652. ed. 2.) Another experienced gentleman in this department of surgery, states, however, that he has never yet seen a perfect example of fungus hæmatodes of the eye in an individual more than five years old. (*R. Middlemore on Dis. of the Eye*, vol. ii. p. 388.) According to Mr. Travers, the only parts of the eye and its appendages, subject to be primarily attacked by cancer, are the lachrymal gland, conjunctiva, and eyelids; while the evidence of many cases has assured him that fungus hæmatodes may originate in any texture of the eye, with the exception of the lens and cornea. (*Synopsis, &c.* p. 216. 222. and 421.) This account, however, differs from that delivered by Mr. Wardrop, and Professor Scarpa, who describe the disease as first commencing in the retina, and particularly at the point where the optic nerve enters the eye. "For (says the latter author), on the first appearance of the yellowish, or greenish spot, the retina on examination is found to be entirely deficient, or, in other words, to have degenerated into the malignant fungus. It is also found, that the choroid membrane, while the fungus hæmatodes is in its incipient state, does not appear to have suffered any remarkable alteration in its texture, and that it is only at a more advanced period of the disease, that this membrane becomes thickened, and separated from its connection with the sclerotica. The choroid membrane, even in the most advanced stage of the disorder, preserves, more than all others, its natural texture." (*On the Principal Diseases of the Eye*, p. 507. ed. 2.) Dr. Mackenzie has observed, that the sclerotica appears to suffer less than any other part of the eye, and that in every case where the disease affected the eyeball, "we were ignorant of its existence before either the optic nerve, or retina, was changed." Mr. Middlemore also declares his belief, that the disease begins either in the retina or optic nerve. (*On Diseases of the Eye*, vol. ii. p. 402.)

The lachrymal gland is sometimes absorbed;

in other instances, projected from the orbit; but, according to Mr. Middlemore's experience, it does become affected with fungus hæmatodes. (Vol. cit. p. 407.)

In cases of fungus hæmatodes, the sight of young subjects is generally destroyed before the attention of parents is excited to the distemper. Frequently, however, a blow, followed by ophthalmy, precedes the growth of the diseased mass. When no external violence has occurred, the first symptom is a trivial fulness of the vessels of the conjunctiva, the iris becoming, at the same time, extremely vascular, and altered in colour, and the pupil dilated and immoveable. There is seldom much complaint made of pain; but the child is sometimes observed to be languid and feverish. In adults, fungus hæmatodes of the eye generally comes on without any apparent cause, though sometimes in consequence of a blow. At first the tunica conjunctiva is slightly reddened, and vision indistinct. The redness and obscurity of sight increases slowly, and an agonizing nocturnal headach is experienced; the eye bursts, and the humours are discharged.

The time of the greatest pain is at the period when the eyeball is greatly distended by the diseased mass, and previously to the rupture of the cornea. This is the time when convulsions are disposed to occur. (See *R. Middlemore on Diseases of the Eye*, vol. ii. p. 395.)

With regard to the cure of fungus hæmatodes of the eye, the only chance of effecting this desirable object depends upon the early extirpation of the diseased organ. It must be acknowledged, however, that most of the operations, in which the morbid eye has been removed, have hitherto proved unsuccessful, owing to a recurrence of the disease. The reason of such ill success may be imputed to the optic nerve and other parts being almost always in a morbid state before an attempt is made to remove the eye. One case, however, described by Mr. Travers, as having its seat in the cellular texture connecting the conjunctiva to the cornea, was operated upon, and no recurrence of the disease had occurred a twelvemonth afterwards. No other texture was affected more than the contiguity and extent of the disease explained. (*Synopsis, &c.* p. 413.) The most successful extirpation of an eye in an advanced stage of this disease, and, perhaps, almost the only satisfactory one at present on record, is that which was performed by Mr. Wishart, the cure remaining complete eighteen months after the operation. (See *Edin. Med. Journ.* vol. xix. p. 51.)

Donega operated in another case, as is alleged, with success. The disease had existed six weeks; and the patient was an infant, twenty months old. (See *Panizza, sul Fungo Midollare dell' Occhio*. Pavia, 1826.) Some observations have been made by Mr. Lawrence on these cases, tending to raise a doubt of their having been examples of fungus hæmatodes. (*On Diseases of the Eye*, p. 623.) The operation has nearly always been found to fail, when the disease is advanced so far, that the posterior chamber is filled by the fungous mass. With the very few exceptions which there are to this statement, it may be correctly said, that, as no internal medicines, nor external applications, afford the least hope of checking any form of the fungus hæmatodes, it is manifest that, when the distemper of the eye exceeds certain bounds, the miserable patient is placed beyond the reach of any effectual aid from surgery. In a case, which I saw in April, 1821, in the London Eye Infirmary, the disease formed a diseased mass, as large as an orange, accompanied with enlarged lymphatic glands over the parotid. The patient was an infant. In this instance, Mr. Lawrence used, as a local application, the liquor opii sedativus, prepared by Battley, which was found to lessen considerably the child's sufferings.

See *Wardrop*'s Obs. on Fungus Hæmatodes. *Scarpa*, on the Principal Diseases of the Eye, chap. 21. *Saunders*, on Diseases of the Eye; and *B. Travers*'s Synopsis of the Diseases of the Eye, 8vo. Lond. 1820. *G. Frick*, on Diseases of the Eye; 8vo. Lond. 1826. *W. Lawrence*, on Diseases of the Eye, 8vo. Lond. 1833. *R. Middlemore*, on Diseases of the Eye, vol. ii. 8vo. Lond. 1835. *W. Mackenzie*, on Diseases of the Eye, 8vo. Lond. 1835. *Panizza*, sul Fungo Midollare dell' Occhio. Pavia, 1826. *Wishart*, in Edin. Med. and Surgical Journ. vol. xix.

Under the terms BRONCHOCELE, MAMMA, TESTICLE, and TUMOUR, will be found descriptions of fungus hæmatodes, or medullary sarcoma, in organs not particularly noticed in the preceding article.

See Dissertations on Inflammation, by *J. Burns*, vol. ii. *Hey's* Practical Obs. in Surgery, ed. 3. *John Abernethy*, Surgical Obs. 8vo. Lond. 1804. *G. Freer*, on Aneurism. 1807. Obs. on Fungus Hæmatodes, or Soft Cancer, by *James Wardrop*, 8vo. Edin. 1809. This last publication is highly deserving of attention; the disease in different organs being well described, and its character discriminated from that of scirrhous cancer.

A case of this disease is related in vol. v. of the Lond. Med. Journ. It was the consequence of an attempt to cure a ganglion by means of a seton, and it proved fatal. *Abernethy*'s Surgical Obs. 8vo. Lond. 1804. See also a Case of diseased Testicle, accompanied with Disease of the Lungs and Brain, by *H. Earle*, in Medico-Chirurg. Trans. vol. iii. p. 59, &c., in which vol. four other cases are recorded by *Mr. Lawrence*, p. 71. et seq. and one by *Mr. Langstaff*, p. 277.; which last I remember to have visited in company with this gentleman and *Mr. Lawrence*, a short time before the patient died. Also *Langstaff*"s Cases and Obs. in the 8th and 9th vols. of the same work. *Ph. J. Roux*, Voyage fait à Londres en 1814; ou Parallèle de la Chirurgie Angloise avec la Chirurgie Françoise, p. 211, &c. *Dupuytren*, Clin. Chir. t. iv. p. 53. *Wm. Kerr, M.D.*, in Cyclopædia of Practical Medicine. *Laennec*, Dict. des Sciences Méd., art. Encéphaloides. *C. Bell*, Surgical Obs. part. iv. *Hodgkin*, in Med. Chir. Trans. vol. xv. *Robert Carswell*, in Illustrations of the Elementary Forms of Disease, fasciculi 2 & 3. 4to. Lond. 1833. *Andral*, Anat. Pathol. t. xi. p. 219. *J. J. Lobstein*, Anat. Pathol. t. xi. p. 419. *Cruveilhier*, Anat. Pathol. liv. iv.—viii.; and Essai sur l'Anat. Pathol. t. i. *James Copland, M.D.*, Dict. of Practical Med. art. Fungoid Disease, 8vo. 1837.

FURUNCULUS. (from *furo*, to rage.) A boil, so named from the violence of the heat and inflammation attending it. A peculiar inflammation, beginning, as Dupuytren believed, in one or more of the prolongations of the interareolar cellular tissue of the cutis.

A boil is a circumscribed, very prominent, hard, deep red, inflammatory swelling, which is exceedingly painful, and commonly terminates in slow and imperfect suppuration. The figure of the tumour is that of a cone, the base of which is considerably below the surface of the skin. Upon the most elevated point of the boil, a small whitish speck presents itself, between the fourth and the eighth day. After the apex of the tumour has turned white, it softens, and then a very small aperture is formed in it, from which a little pus, mixed with blood, is discharged, and within which, a portion of dead cellular tissue, the core, may be perceived. By Dupuytren, and other French pathologists, the manner in which this is produced, is explained as follows: a boil is only an inflammation of the prolongations of cellular tissue, which penetrate between the areolæ of the cutis, accompanied by the vessels and nerves, distributed to the surface of the skin. With this inflammation is combined that of the cutis itself, and consequently, these cellulo-vascular and nervous prolongations suffer constriction, partly from their own enlargement, and partly from the increased narrowness of the openings through which they pass. Hence, their nutrition is interrupted, and they are converted into a slough, called the *core*. (See *M. Solon, in Dict. de Méd. et de Chir. Pratiques, art. Furoncle;* also *Dupuytren, in Clin. Chir*. t. iv. p. 210.)

The complaint is not attended with fever, except when the tumour is larger than usual, situated on a sensible part, or when several boils occur at the same time in different places. In the last circumstance, they often produce in children, and even in irritable adults, restlessness, loss of appetite, spasms, &c. When boils are situated in the perineum, between the anus and the scrotum, there may be difficulty in making water. Sometimes, when placed on the nape of the neck, shoulder, or thigh, they excite inflammation of the lymphatic vessels and glands of the neck, armpit, or groin. (See *Rayer, Mal. de la Peau*, t. ii. p. 548.) They rarely exceed a pigeon's egg in size, and may originate on any part of the body, though it is most common for them to take place on the nates, the thighs, the armpit, the nape of the neck, the back, and in other regions where the skin is thickest, and the prolongations of the cellular tissue most developed.

Young persons, and especially those of plethoric habits, are most subject to boils. The disease occurs with most frequency in the spring. (*Lassus, Pathologie Chir*. t. i. p. 16.) It is sometimes accompanied by a disordered state of the gastric organs. (*Nosographie Chir*. t. i. p. 124. edit. 2.) Frequently boils arise without any evident cause, and apparently in healthy constitutions. At other times, they follow eruptive diseases and typhus. (*W. Gibson, Institutes, &c. of Surgery*, p. 48. vol. i.) In many cases, several boils present themselves, either at once, or in succession, on various parts of the body.

The suppuration attending a boil is never perfect, and the matter which forms, is frequently tinged with blood. The central portion of dead cellular tissue, or the *core*, is mostly detached about the tenth or twelfth day, leaving an open cylindrical cavity, extending from the apex to the base of the tumour. The pain now ceases; the skin contracts; the cavity becomes obliterated; and the cure is completed in about a fortnight. (See *Rayer, Mal. de la Peau*, t. ii. p. 547.)

The experiments of Dumeril and Bretonneau prove, that a boil may sometimes be stopped by an early application of caustic; a plan, however, rarely tried.

In a very few cases, perhaps, it may be proper to try to resolve boils, by means of bleeding, gentle evacuations, low diet, and cold applications. In the generality of instances, suppuration must be promoted, by the use of emollient poultices. The tumour, when allowed to burst, generally does so at its apex. However, as the opening is long in forming, and too small to allow the sloughy cellular substance to be discharged, it is best, as soon as matter is known to exist in the tumour, to make a free opening with a lancet, and immediately afterwards to press out the matter and dead cellular tissue. This having been accomplished, healthy pus will be secreted, and the part will granulate and heal.

For the purpose of stimulating the cavity, and causing it to fill up, Professor Gibson, of Philadelphia, has sometimes employed a lotion of nitrate of silver.

Where there is reason to suppose the gastric organs to be in a disordered state, an emetic should be given in the early part of the treatment, and afterwards small repeated doses of any of the mild purging salts.

When an indolent hardness continues, after the inflammatory and suppurative state of boils has been removed, the part should be rubbed with camphorated mercurial ointment.

Besides the above *acute* boil, authors describe a *chronic* one, which frequently occurs in subjects who have suffered severely from the small-pox, measles, lues venerea, scrofula, and in constitutions injured by the use of mercury. The *chronic* boil is commonly situated upon the extremities, is of the same size as the acute one, has a hard base, is not attended with much pain, nor any considerable discolouration of the skin, until suppuration is far advanced, and the matter is seldom quite formed before the end of three or four weeks. Sometimes several boils of the chronic kind occur together, or follow one another in the same patient. The discharge is always thinner than good pus, and when the boil is large, and has been long in suppurating, a great deal of sloughy cellular tissue must be cast off, before the sore will heal.

The principal thing, requisite in the local treatment of all furunculous and carbuncular tumours, is to make an early free opening into them, and to press out the matter and sloughs, employing emollient poultices, till all the mortified parts are detached and removed, and afterwards simple, or more or less stimulating dressings.

See *Pearson*'s Principles of Surgery. *Richter*, Anfangsgründe der Wundarzn. b. 1. *Lassus*, Pathologie Chir. t. i. p. 15. *W. Gibson*'s Institutes of Surgery, vol. i. Philadelphia, 1824. *C. J. M. Langenbeck*, Nosologie, &c. b.i. p. 357. Gott. 1822. *M. J. Chelius*, Handb. der Chir. b. i. p. 74. Heidelb. 1826. *Dupuytren*. Clin. Chir. t. iv p. 110. *Rayer*, Maladies de la Peau, t. ii. p. 546. 8vo. Paris, 1826.

GANGLION. (*Γαγγλίον.*) In surgery, an encysted tumour, formed in the course of a tendon, or its fibrous sheath. It is, as I have said, an encysted, circumscribed swelling, commonly free from pain, causing no alteration in the colour of the skin, and formed upon tendons in different parts of the body, but most frequently upon the hand or wrist. A French gentleman consulted me, who had one upon the upper part of his foot, which created a considerable weakness in the motion of the ankle. A ganglion has been met with over the tendon of the trochlearis, and also that of the external head of the gastromenius. (*Aston Key*, in *Guy's Hospital Reports*, vol. i. p. 416, 417.) An example is recorded, in which a ganglion, situated exactly over the arteria radialis and the arteria superficialis volæ, was at first supposed to be an aneurism. (See *Edin. Med. and Surg. Journ. for April*, 1821.)

Ganglions often possess considerable elasticity. They may occur unpreceded by any accident; but, frequently are the consequence of bruises and violent sprains. When opened, they are sometimes found to be filled with a viscid transparent fluid, resembling white of egg, or rather jelly. As Mr. Aston Key has observed, the contents of a ganglionic tumour differ from those of a common bursa mucosa. The latter secretes a fluid like ordinary synovia; the ganglion most usually contains a substance like the outer layers of the crystalline lens, soft, viscid, and nearly solid. (See *Guy's Hospital Reports*, vol. i. p. 415.)

Different pathological views are entertained respecting the formation of ganglions. In France, these tumours are regarded as dropsies or hydroceles of the sheaths of tendons. Most of them, it is observed, form over small compact joints, like those of the carpus and tarsus, possessing little motion, and covered by dense fibrous layers; or else, in the course of the sheaths of the tendons of the hand, or foot. In these small arthrodial joints, and in the sheaths of tendons, the synovial membrane being covered by strong fibrous textures, cannot undergo any uniform distension by an accumulation of their secretion, which causes a protrusion of the synovial membrane at some interspace of the fibrous investment, which, however, extends over other parts of the internal cyst. It is also alleged, that the ganglion has a communication with the interior of the fibrous sheath. (See *Bégin*, in *Dict. de Méd. et de Chir. Pratiques*, art. *Ganglion.*) Mr. Aston Key joins in representing ganglions as consisting of a double bag: the outer one tendinous and firm; the inner, like a synovial one, thin and secreting; but that, in most instances, the outer one cannot be separated from the inner. However, he differs from M. Bégin in regarding a ganglion as a new structure. (*Guy's Hospital Reports*, vol. i. p. 415.)

Stimulant applications sometimes succeed in curing ganglions, and, at one time, frictions with oleum origani, or with liniment of camphor, strengthened with tinct. canthar., were a common method. Of late years, friction with iodine liniments and the ointment of hydriodate of potash, has also had extensive trials. I have often seen the tumours lessened by these means, but seldom cured; for, no sooner has the friction been discontinued, than the fluid in the cyst has accumulated again.

Compression is often employed. Persons with ganglions have been recommended to press upon them strongly with their thumb, several times a day. After this has been repeated very often, the tumour has sometimes disappeared. Another method is to make pressure on ganglions by means of a piece of sheet-lead, bound upon the part with a bandage. In conjunction with this treatment, frictions with stimulating liniments, or camphorated mercurial ointment are usually tried.

Setons have been introduced through ganglions, with the view of curing them. This method, however, in a few examples, has excited the growth of a malignant fungus. (*Med. Journ.* vol. v.)

For the ganglion of the tendinous investment of the patella, a seton is occasionally employed by Mr. Key. " Blisters, stimulating plasters, and pressure with a bandage (he observes), are often resorted to, with advantage. The more effectual plan of dispersing them altogether, is to puncture them with a lancet, to let out the contained fluid, and to employ firm pressure with a bandage and plaster. If this does not prove permanently successful, the seton becomes the most ready, the most mild, and the most effective remedy." (*Op. cit.* vol. i. p. 417.)

Ganglions may be cured by pressure sufficient to rupture the cyst; and some authors have recommended putting the hand affected upon a table, and then striking the ganglion several times with the fist, the back of a book, or a mallet. The cyst of a recent ganglion may also be burst, by compressing it strongly with the thumbs, with or without the intervention of a piece of money; the fluid is effused into the adjacent cellular membrane; and, pressure being now employed, the opposite sides of the cavity become united by the adhesive inflammation, and the recurrence of the disease is prevented. On this principle, Sir Astley Cooper has often cured the disease.

For many years, I have adopted the plan of curing ordinary ganglions by making a small puncture in them, discharging their contents, and then applying pressure. I have never seen any unpleasant effects follow this practice, and it is almost always successful. In 1825, Mr. Wm. Cumin, of Glasgow, published some cases and observations in favour of this method. He made the puncture with a cataract needle. (See *Edin. Med. Journ.* No. lxxxiv. p. 95.) I have usually drawn the skin a little towards one side, and then made a small opening in the ganglion with a lancet. In the treatment of ganglions situated on the back of the wrist, Mr. Aston Key also prefers a small puncture. For those which occupy the base of the palmar side of the fingers, he considers the puncture the only remedy; for the cyst cannot be ruptured, and blisters rarely answer. (See *Guy's Hospital Reports*, vol. i. p. 416.)

When ganglions resist all attempts to disperse, or palliate them; when they become extremely inconvenient, either by obstructing the functions of a joint, or causing pain; they should be carefully dissected out, by first making a longitudinal incision in the skin covering them, then separating the cyst on every side from the contiguous parts, and, lastly, cutting every particle of it off the subjacent tendon or fascia.

The operation being accomplished, the skin is to be brought together with sticking plaster, and a compress placed over the situation of the tumour, with the view of healing the wound and the cavity by adhesion.

When the ganglion has burst, or is ulcerated, it is best to remove the diseased skin, together with the cyst; and of course the incision must be oval, or circular, as may seem most convenient. The grand object is not to allow any particle of the cyst to remain behind, as it would be very likely to throw out a fungus, and prevent a cure. In *Warner's Cases of Surgery* is an account of two considerable ganglions, which this gentleman, in imitation of Celsus and Paulus Ægineta, thought it right to extirpate. These had become adherent to the tendons of the fingers. In the operation, he was obliged to cut the transverse ligament of the wrist; and the patients, who before could not shut their hands, nor close their fingers, perfectly regained the use of these parts. Mr. Gooch relates a case of the same kind, which had been occasioned by a violent bruise, three or four years before. The tumour reached from the wrist to the middle of the hand, and created a great deal of pain. Mr. Gooch extirpated it, and then restored the position of the hand, and free motion of the joint, by the use of emollient applications, and suitable pressure, made with a machine constructed for the purpose.

Other cases, confirming the safety of cutting out ganglions, are recorded in the London Medical Journal for 1787. p. 154; by *Eller*, in Mém. de l'Acad. des Sciences de Berlin, t. ii. ann. 1746; *Schmucker*, in Chir. Wahrnehmungen, b. i. p. 332; *Girard*, Lupiologie. See *Warner*'s Cases in Surgery. Chirurgical Works of *B. Gooch*, vol. ii. p. 376. *Richter*, Anfangsgr. der Wundarzn. b. i. Lassus, Pathologie Chir. t. i. p. 399. Dict. des Sciences, Méd. t. xvii. p. 311. *Cumin*, in Edin. Med. and Surgical Journ. No. 84. *C. Aston Key*, in Guy's Hospital Reports, vol. i. 8vo. Lond. 1836.

GANGRENE (from *γραίνω*, to feed upon). So named for its eating away the flesh. Authors have generally distinguished mortification into two stages: the first, or incipient one, they name *gangrene*, which is attended with a sudden diminution of pain; a livid discoloration of the part, which after being yellowish, becomes of a greenish hue; a detachment of the cuticle, under which a turbid fluid is effused; and lastly on touching the part, a crepitus is perceptible, owing to the generation of air in the gangrenous parts.

When the part has become quite cold, black, fibrous, incapable of moving, and destitute of all feeling, circulation, and life; this is the second stage of mortification, termed *sphacelus*. Gangrene, however, is frequently used synonymously with the word mortification. (See *Mortification*.)

GASTROCELE (from *γαστὴρ*, the stomach, and *κήλη*, a tumour). A hernia of the stomach.

GASTRORAPHIA, or GASTRORAPHE. (from *γαστὴρ*, the belly, and *ῥαφὴ*, a suture.) A suture of the belly, or some of its contents.

Although the term *gastroraphe*, in strictness of etymology, signifies the sewing up of any wound of the belly, yet Mr. S. Sharp informs us, that, in his time, the word implied, that the wound of the abdomen was complicated with another of the bowels.

The operation of sewing up a wound in the bowels, can only take place when they fall out of the abdomen, and the wound in them is visible. And, indeed, even in these circumstances, the employment of sutures is a practice, the propriety of which is questionable, as will be further considered in the article *Wounds*.

Gastroraphe, or merely sewing up a wound of the parietes of the abdomen, is usually done with the common interrupted suture (see *Suture*), but formerly sometimes with the quilled one.

In two or three days, the sutures may generally be removed, and sticking plaster alone employed. (See *Wounds of the Abdomen*.)

M. Pibrac, in the third volume of the *Mém. de l'Acad. Royale de Chir.*, records several interesting cases, which fully prove that wounds of the belly readily unite by means of a suitable posture and a proper bandage, without the practice of gastroraphe. These cases, however, are less decisive and convincing (if possible to be so) than the relations of the Cæsarean operation, the extensive wound of which has often been healed by simple means, after the failure of sutures.

Under certain circumstances, however, it may be essentially necessary to practise gastroraphe. For instance, were a large wound to be made across the parietes of the abdomen, a suture might become indispensably requisite to prevent the protrusion of the bowels. Yet even in this case, the sutures should be as few in number as possible. (See *Sutures.*)

I shall conclude this article with a fact, perhaps more curious than instructive, related by M. Bordier, of Pondicherry, in the *Journal de Médecine*, vol. xxvi. p. 538. An Indian soldier, angry with his wife, killed her, and attempted to destroy himself by giving himself a wound with a broad kind of dagger in the abdomen, so as to cause a protrusion of the bowels. A doctor of the country, being sent for, dissected between the muscles and skin, and introduced a thin piece of lead, which kept up the bowels. The wound soon healed up, the lead having produced no inconvenience. The man was afterwards hanged, and M. Bordier, when the body was opened, assured himself more particularly of the fact.

GLAUCOMA (from *γλαυκὸς*, bluish green,) is generally defined to be a greenish opacity of the vitreous humour, attended with the loss or a considerable impairment of sight. (*Weller on Dis. of the Eye, transl. by Monteith*, vol. ii. p. 27.) Mr. Lawrence describes the colour as sea-green, clear green, muddy green, or yellowish green. (*On Dis. of the Eye*, p. 389.) As will be presently explained, however, the vitreous humour is not invariably implicated in some of the cases, perhaps incorrectly classed with glaucoma. Mr. Guthrie represents the disease as essentially consisting in an alteration of the component parts of the vitreous humour, accompanied with derangement of the structure of the hyaloid membrane, retina, and tunica choroidea, the vessels of which are always more or less varicose. (*Operative Surgery of the Eye*, p. 214.) Professor Beer considers the subjects of glaucoma, and the cataracta viridis, or glaucomatosa, together. He observes, that these diseases occur rather frequently, not only as true effects of inflammation of the eye, but sometimes quite unpreceded by this affection. Although glaucoma may continue for a long time as the only disorder, without the crystalline lens being changed in the slightest degree; yet Beer has never seen the case reversed, and the lens become altered as it does in glaucoma first, and the vitreous humour afterwards. In what this author describes as gouty ophthalmy, glaucoma is said to come on with the following symptoms: the iris is not observed to expand, but rather to become contracted; the pupil is not equally dilated, but extends more towards the canthi, the iris at length becoming scarcely perceptible towards each angle of the eye, especially the outer one, and the pupil of course assuming something of the appearance which is seen in the eye of a ruminating animal. In a case, however, which I once saw in the London Eye Infirmary, under Mr. Lawrence, it was particularly remarked, that the diameter of the pupil was not greatest in the transverse direction; a circumstance, which Beer's account would lead us to expect as constant. And it merits notice, that as the iris shrinks towards the margin of the cornea, its pupillary edge is inverted towards the lens, so that its smaller circle completely disappears. In this very dilated state of the pupil, a grey greenish opacity is perceived, seeming to be very deep, and arising from a real loss of transparency in the vitreous humour. At this period, the lens evidently becomes opaque, acquiring a sea green hue, and the cataracta viridis, or glaucomatosa, now swells and appears to project forwards into the anterior chamber. The pain then becomes more incessant and violent; the varicose affection of the eyeball seriously increases; and the eyesight, which began hourly to diminish from the moment when the pupil was first observed to be in any degree expanded and opaque, and the iris motionless, is now so entirely destroyed, that not the slightest perception of *external* light remains, though the patient may vainly congratulate himself on discerning luminous appearances produced within the eye itself, in the form of a fiery, shining circle, especially when the organ is gently pressed upon. An eye in this condition (says Beer) has really a look as if it were dead, the cornea being as flaccid and void of lustre as in a corpse. Finally, when these symptoms have attained their utmost pitch, an atrophy of the eyeball follows, and the painful sensations about the organ cease. In corpulent individuals, however, they still continue with greater violence. Sooner or later, the other eye is also attacked with arthritic iritis, or ophthalmy, or becomes affected with glaucoma, which is ushered in by violent and incessant headach. (*Beer, Lehre von den Augenkrankheiten,* b. i. p. 581, &c. 8vo. Wien, 1813.) According to this author, glaucoma and the green cataract are never the consequences of any description of ophthalmy, but what he terms *arthritic.* (b. ii. p. 255. Wien, 1817.) Mr. Lawrence inclines to Beer's opinion; for, he observes, that glaucoma appears to him to be a chronic form of arthritic inflammation of the internal tunics; and, he adds, that it certainly occurs more frequently in gouty persons than others. (*On Dis. of the Eye*, p. 390.) By another experienced practitioner, glaucoma is also stated to be frequently combined with arthritic inflammation. (See *Mackenzie on Dis. of the Eye*, p. 825. ed. ii.) On the other hand, Mr. Guthrie regards the inflammation as really an unhealthy disorganising inflammation, not necessarily dependent upon, nor connected with gout. (*Operative Surgery of the Eye*, p. 216.) I have stated that glaucoma is usually regarded as an opacity of the vitreous humour. The following, however, were the particulars observed by Dr. Mackenzie in the dissection of several glaucomatous eyes. 1. The lens of a yellow, amber, or reddish brown colour, especially towards its centre; its consistence firm, and its transparency perfect, or nearly so. In some cases, however, the reddish brown colour of the central part of the posterior lamellæ was so deep as considerably to impair its transparency. 2. The vitreous humour in a fluid state; perfectly pellucid, colourless, or slightly yellow: no trace of hyaloid membrane. 3. The choroid coat, and especially the portion of it in contact with the retina, of a light brown colour, with little or no appearance of pigmentum nigrum. 4. In the retina, no trace of limbus luteus, or foramen centrale. (See *Mackenzie on Dis. of the Eye*, p. 827. ed. ii.)

In some other cases which Mr. Middlemore had an opportunity of dissecting, the vitreous humour was of a yellow tinge, as remarked by Scarpa in his examinations; and the lens had undergone no other alteration, than such as generally takes place in advanced life, being of a green, deep yellow, or amber. The vitreous humour was not much increased in quantity. The choroid pigment was in a great measure absent; and the septa of the hyaloid membrane were absorbed. (See *Middlemore on Dis. of the Eye*, vol. ii. p. 7.)

This gentleman describes two varieties of glaucoma: first, that which occurs in old age, and is productive of mere impairment of vision, without any material degree of pain, and, as he believes, without any inflammation; but in which the transparency of the vitreous humour is always diminished, and its colour altered, either to a yellowish or greenish tinge. Secondly, that variety which takes place from inflammation of the septa of the vitreous humour, which is marked by symptoms of a more or less severe character; is often attended with chronic inflammation of other deeply seated textures, and usually leads to the total destruction of vision. Hence, says Mr. Middlemore, the appearances of the membranes and humours will not always be the same.

In Mr. Lawrence's valuable treatise are collected the particulars of other dissections of glaucomatous eyes by Walther, Eble, and Rosas. In the eyes of a man examined by Walther, the lens and vitreous humour were in the normal state, and perfectly transparent. In the retinæ were numerous black and partly reddish spots, roundish, and of various size. In a glaucomatous eye dissected by Eble, the covering of the uvea was reddish brown, instead of the usual dark pigment. The vessels of the choroid were varicose in several places; and the pigment, which was much lighter than natural, had disappeared in several places. The retina was extraordinarily soft. The capsule was partially opaque; and the lens small, firm, and of amber colour. The whole vitreous humour had a yellowish tint; and there were scattered through it twenty or thirty points of a grey, brownish green, or sea green colour. In another case, that of a man of 70, who had frequently experienced arthritic inflammation of the eyes, the vitreous humour was partially thickened, and firmer. The retina exhibited some varicose enlargements, and it was of a dark grey colour.

On this part of the subject, Mr. Lawrence offers the following judicious reflections: "From the preceding pathological facts, we may conclude, that the vitreous humour is not originally and essentially the seat of glaucoma; we may perhaps draw the further inference, that affections, in some respects different, are included under that term. When we consider the numerous gradations between the acute internal arthritic ophthalmia which destroys sight at once, and the imperfection of vision which comes on in glaucoma, properly so called; also, that difference of morbid changes may be expected, according to the stage of the complaint; we shall not be surprised at finding, that the results of examination are not always alike." (See *Lawrence on Dis. of the Eye*, p. 392.)

In glaucoma, the pupil is green, or yellowish green; and, if the eye be looked at laterally, no discolouration is seen. In cataract, the pupil is grey, or greyish white, and it has the same appearance in whatever direction it is viewed. In glaucoma, the loss of vision is not in direct proportion to the change of colour in the pupil. With an inconsiderable change, vision may be entirely destroyed, or seriously impaired; but in cataract, there is a direct proportion between the degree of opacity and the injury to sight. In cataract, vision is best in a weak light; in glaucoma, it is stronger in a powerful light, because as the retina is less sensible, more light is required to make an impression on it. (*Lawrence, Op.* cit. p. 393.)

Glaucoma, after it is conjoined with a varicose disease of the eyeball, is set down by Beer as incurable. According to Weller, when the vitreous humour first begins to be muddy, the disease may sometimes be checked. (*On Dis. of the Eye*, vol. ii. p. 29.)

Beer states, that no treatment will avail in checking glaucoma, and preventing complete amaurosis. The prognosis is unquestionably most unpromising. I have seen many cases of glaucoma treated, but never with success. Mr. Lawrence holds out more encouragement than Beer, and recommends antiphlogistic treatment; as cupping; active purgatives; mercury, long continued, but not used so as to cause salivation; a regulated diet, and repose of the organ. (*On Dis. of the Eye*, p. 394.) Counter-irritation has also been found useful, and especially frictions with antimonial ointment between the shoulders. Arthritic inflammation of the eye is often greatly benefited by tonics, as precipitated carbonate of iron and sulphate of quinine. After depletion, one very experienced practitioner sanctions the trial of them in glaucoma. (See *Mackenzie on Dis. of the Eye*, p. 830, ed. ii.) On the principle of there being a superabundance of dissolved vitreous humour, the same gentleman conceives that occasionally puncturing the sclerotica and choroid, with a broad iris knife, might prove serviceable. He also states, that he has known glaucoma operated upon for cataract, and the removal of the amber coloured lens followed by a considerable accession of vision. But as he had also known violent inflammation ensue, he does not venture to recommend this proceeding for general adoption. A grooved cataract needle, as recommended by Mr. Middlemore, seems to me the best instrument for puncturing the vitreous humour. Mr. Middlemore finds that no remedies will interrupt the progress of *senile glaucoma*, and he deems no treatment requisite, unless circumstances denote that the affection is rendered worse by the existence of chronic inflammation of the septa of the vitreous humour or neighbouring textures. If this be the case, he would employ mild purgatives, and, perhaps, a little mercury, with permanent counterirritation and the avoidance of all exertion of the eye, particularly in artificial light, or on minute objects.

In the *acute* or *inflammatory* glaucoma, Mr. Middlemore is an advocate for antiphlogistic treatment, followed up by a seton, or blister to the temple, or above the eye-brow. Sometimes he excites slight irritation on the skin of the temple, with nitrate of silver. Occasionally he has punctured the vitreous humour with a very fine grooved needle. He advises this to be done, whenever there is much local pain, evidently depending on the tension of the globe, "and particularly when vision is nearly destroyed, and the opposite organ is becoming similarly affected." In one or two cases, where the muddiness of the vitreous humour was evidently consequent on inflammation, Mr. Middlemore, after the subsidence of the latter affection, discharged the greater part of the turbid fluid with the needle, in the hope that the new secretion would be more transparent; and, he states, that he has practised this operation with the greatest advantage to the patient's vision. (See *R. Middlemore, op.* cit. vol. ii. p. 19—20.) The dilatation of the pupil with belladonna sometimes improves vision, when this partly remains; but, the benefit is merely temporary; and sometimes it causes an increased confusion of sight.

See also, Tr. *G. Benedict*, de Morbis Humoris Vitrei, 4to. Lips. 1829. *G. J. Guthrie*, on Operative Surgery of the Eye, 8vo. ed. 2. Lond. 1827. *C. H. Weller*, on Dis. of the Eye, tr. by *G. C. Monteath*, 2 vols. 8vo. 1821; or rather the last German ed. 8vo. 1826. Also, *Jones*, Ophthalmologiæ, Fasc. 1. *W. Lawrence*, on Dis. of the Eye, 8vo. Lond. 1833. *W. Mackenzie*, in Glasgow Med. Journ. vol. iii. p. 259; and a Treatise on Dis. of the Eye, ed. 2. 8vo. Lond. 1835. Ph. Tr. *Walther*, Abhand Augen, &c. Landsh. 1810. *Eble*, in Ammon's Zeitschrift, vol. i. *R. Middlemore*, on Dis. of the Eye, vol. ii. 8vo. Lond. 1835.

GLEET. By the term *gleet* is commonly understood a continued running, or discharge, after the inflammatory symptoms of a clap have for some time ceased, unattended with pain, scalding in making water, &c. Mr. Hunter remarks, that it differs from a gonorrhœa in being uninfectious, and in the discharge consisting of globular bodies, contained in a slimy mucus, instead of serum. He says, that a gleet seems to take its rise from a habit of action which the parts have contracted. The disease, however, sometimes stops of itself, even after every method has been ineffectually tried. This probably depends upon accidental changes in the constitution, and not at all upon the nature of the disease itself. Mr. Hunter had a suspicion, that some gleets were connected with scrofula. Certain it is, the sea-bath cures more gleets than the common cold bath, or any other mode of bathing; and a cure may sometimes, but not always, be accomplished by an injection of diluted sea-water.

Gleets are often attended with a relaxed constitution. They also sometimes arise from other affections of the urethra, besides gonorrhœa. A stricture is almost always accompanied with a gleet; and so sometimes is disease of the prostate gland.

It is remarked by Mr. Hunter, that if a gleet does not arise from any evident cause, and cannot be supposed to be a return of a former gleet, in consequence of a gonorrhœa, either a stricture or diseased prostate gland is to be suspected: an inquiry should be made whether the stream of urine is smaller than common, whether there is any difficulty in voiding it, and whether the calls to make it are frequent. If there should be such symptoms, a bougie, rather under the common size, should be introduced; and, if it passes into the bladder with tolerable ease, and the patient is nearly fifty, or upwards, the disease is probably in the prostate gland, which should next be examined. (See *Urethra, Strictures of*; and *Prostate Gland.*)

Balsams, turpentines, and the tinctura canth. given internally, are of service, especially in slight cases; and when they are useful, they prove so almost immediately. Hence, if they had neither lessened nor removed the gleet in five or six days, Mr. Hunter never continued them longer. The same observation applies to cubebs, so celebrated as a remedy for gonorrhœa and gleet, and the common dose of which is ʒij in any convenient fluid three times a day. As the discharge, when removed, is apt to recur, such medicines should be continued for some time after the symptoms have disappeared.

When the whole constitution is weak, the cold bath, sea-bath, bark and steel medicines may be given.

With regard to local applications, the astringents commonly used are, lotions of sulphate of zinc, alum, or acetate of lead.

Irritating applications consist either of injections, or bougies. Violent exercise may be considered as having the same effect. Such applications should never be used till the other methods have been fully tried, and found unsuccessful. They at first increase the discharge, and, on this account, are sometimes abandoned too early. Two grains of the oxymuriate of mercury, dissolved in eight ounces of distilled water, make a very good irritating injection. In irritable habits, such an application may do great harm, and therefore, if possible, the capability of the parts to bear its employment, should first be made out.

Bougies sometimes act violently, but Mr. Hunter thought them more efficacious than injections. A simple unmedicated one is generally sufficient, and must be used a month or six weeks, before the cure can be depended upon. Bougies, medicated with camphor or turpentine, were formerly employed for the cure of gleet; they did not require so long a trial as common bougies: at present, I believe, they are not used by any surgeon of eminence. Whatever bougies are employed should be under the common size.

Mr. Hunter knew a gleet disappear on the breaking out of two chancres on the glans. Gleets have also been cured by a blister on the under side of the urethra, and by electricity.

In every plan of treatment, rest, or quietness, is generally of great consequence; but, after the failure of the usual modes, riding on horseback will sometimes immediately effect a cure.

Regularity and moderation in diet are to be observed.

Intercourse with women often causes a return or increase of gleet; and, in such cases, it gives suspicion of a fresh infection; but, the difference between this and a fresh infection is, that here the return is almost immediately after the connexion.

Gleets in women are cured nearly in the same manner as those of men. Turpentines, however, have no specific effect on the vagina; and the astringent injections used should be stronger than those intended for male patients.

GLOSSOCATOCHUS (from γλῶσσα, the tongue, and κατέχω, to depress). The ancient glossocatochus was a sort of forceps, one of the blades of which served to depress the tongue, while the other was applied under the chin.

GOITRE. See *Bronchocele.*

GONORRHŒA. (from γονὴ, the semen, and ῥέω, to flow). Etymologically, an involuntary discharge of the semen; but always, according to modern surgery, a discharge of purulent infectious matter, from the urethra in the male, and from the vagina and surfaces of the labia, nymphæ, clitoris, and, as is alleged to have been made out by the late M. Cullerier, sometimes even from the lining of the uterus in the female subject. (See *Dict. de Méd. et de Chir. Pratiques*, t. iv. p. 149.)

Dr. Swediaur, after censuring the etymological import, as conveying an erroneous idea, says, if a Greek name is to be retained, he would call it blennorrhagia, from βλέννα, mucus, and ῥέω, to flow. However, as most of the moderns consider the discharge as pus, not mucus, the etymological import of blenorrhœa is as objectionable as that of gonorrhœa. Mr. Howship has repeatedly examined the discharge with a microscope, but without perceiving any essential difference between such discharge and the pus effused from an ulcer. (*On Complaints affecting the Secretion and Excretion of the Urine*, p. 260.) In English, the disease is commonly called a *clap*, from an old French word *clapises*, which were public shops, kept and inhabted by single prostitutes, and generally confined to a particular quarter of the town, as is even now the case in several of the great towns in Italy. In German, the disorder is named *ein tripper*, from dripping; and in French, *une chaudepisse*, from the heat and scalding in making water.

Mr. Wallace, of Dublin, objects to the terms gonorrhœa and blennorrhagia, and proposes to name the disease *catarrhal primary syphilis.* (*On Venereal Disease and its Varieties*, p. 233. London 8vo. 1833.)

When an irritating matter of any kind is applied to a secreting surface, it increases that secretion, and changes it from its natural state to some other. In the present instance, it is changed from mucus to pus.

Till about the year 1753, it was generally supposed, that the matter from the urethra, in cases of gonorrhœa, arose from ulcers in the passage; but, about that time it was ascertained, that pus might be secreted without a breach of substance. It was first accidentally proved, by dissection, that pus might be formed in the sac of the pleura, without ulceration: and Mr. Hunter afterwards examined the urethra of malefactors and others, who had been executed, or died, while known to be affected with gonorrhœa, and demonstrated, that the canal was entirely free from every appearance of ulcer.

The time when a gonorrhœa first appears, after infection, is extremely various. It generally comes on sooner than a chancre. Mr. Hunter had reason to believe that, in some instances, the disease began in a few hours; while, in others, six weeks previously elapsed; but he had known it begin at all the intermediate periods. However, it was his opinion, that about six, eight, ten, or twelve days after infection, is the most common period. In an immense majority of cases, M. M. Ratier and Cullerier have found the period between the third and seventh day after coition, as that in which a gonorrhœa most frequently commences. (See *Dict. de Méd. et de Chir. Pratiques*, art. Blennorrhagie.)

The surface of the urethra is subject to inflammation and suppuration, from various other causes besides the venereal poison; and sometimes discharges happen spontaneously, when no immediate cause can be assigned. Such may be called *simple* gonorrhœa, having nothing of the venereal infection in them.

M. M. Cullerier, and Ratier assert, that an intense gonorrhœa may occur from venereal excess, between two individuals, whose genitals are perfectly sound, and that either one or both parties may experience the disorder. They declare that they have had many opportunities of verifying this fact. Amongst other patients, they visited one woman, who apparently enjoyed perfect health, and yet communicated gonorrhœa to all who had connexion with her. They mention also a girl who gave a most severe clap to a young man, though she never had had any venereal complaint herself, and was found on examination to be quite free from disease. (See *Dict. de Méd. et de Chir. Pratiques*, art. Blennorrhagie.) These statements agree with those made many years ago by several surgeons of the British army. (See *Venereal Disease.*) I may here observe, however, that the secretions from the pudenda may not be healthy, and yet no appearances of disease may admit of detection even by ocular examination of the parts.

Mr. Hunter knew of cases, in which the urethra sympathised with the cutting of a tooth, and all the symptoms of a gonorrhœa were produced. This happened several times to the same patient. The urethra has been suspected to be sometimes the seat of the gout; and Mr. Hunter was acquainted with instances of its being the seat of rheumatism. These occurrences M. M. Cullerier and Ratier have never noticed, and when they do happen, are deemed by them to be merely accidental coincidences. (See *Dict. de Med. et de Chir. Pratique*, art. Blennorrhagie.)

Mechanical and chemical irritations of the urethra, or of those surfaces of the female pudenda which are the seat of gonorrhœa, may excite it. Contusion and forcible distention of the female pudenda will bring it on. In cases of violation of female children, a discharge usually follows; and hence the person accused of the crime, is commonly alleged to have been guilty also of infecting the injured party. But, it is of importance, as a subject of medical jurisprudence to be aware, that the discharge frequently arises in the party violated from the causes above specified, without the prisoner having had any venereal complaint himself. Were this fact not remembered, a guilty person might be acquitted, on the ground that he could not have infected the child, as it was ascertained that he had no disease about him.

Men who cohabit with leucorrhœal women, or at the period of the menses, or lochia, often experience a discharge from the urethra, in consequence of such connexion. M. M. Swediaur, Cullerier, and Ratier have all ascertained by experiments, that acute inflammation of the urethra, and a purulent discharge may be excited by injecting into the passage diluted liquid ammonia. (See *Dict. de Méd. et de Chir. Pratiques*, art. Blennorrhagie.) What experienced surgeon is unaware of a discharge from the urethra being often excited by the mechanical irritation of bougies? These facts make it perfectly obvious, that a discharge from the urethra is not necessarily a venereal complaint, or in any way connected with the syphilitic poison.

Although catarrhal syphilis, (as Mr. Wallace terms gonorrhœa), occurs mostly on the mucous or muco-cutaneous surface of the genital organs, he remarks, that it may take place on any surfaces of these descriptions to which the venereal poison has been applied, as those of the eye, rectum, &c. (See *Wallace on Ven. Dis.* p. 236.) This gentleman seems thus to advocate the identity of the poisons of syphilis, and one species of gonorrhœa; but, he observes, that as "we are not at present acquainted with any symptoms, upon which we can always rely with confidence, to distinguish discharges, produced by other causes of irritation, we must not think of attributing to this poison all, or even a majority of the discharges of this kind, which we meet with in practice." (*ib.*)

When a secreting surface has once received the inflammatory action, its secretions are increased and visibly altered. Also, when irritation has produced inflammation, and an ulcer in the solid parts, a secretion of matter takes place, the intention of which, in both, seems to be to wash away the irritating matter. But, in inflammations, arising from specific or morbid poisons, the irritation cannot be thus got rid of; for, although the first irritating matter be washed away, yet, the new matter has the same quality as the original had; and, therefore, upon the same principle, it would produce a perpetual source of irritations, even if the venereal inflammation, like many other specific diseases, were not, what it really is, kept up by the specific quality of the inflammation itself. This inflammation seems, however, to be only capable of lasting a limited time, the symptoms peculiar to it vanishing of themselves, by the parts becoming less and less susceptible of irritation; and the subsequent matter can have no power of continuing the original irritation, for otherwise there would be no end to the disease. The time, which the susceptibility of the irritation lasts, must depend upon difference in the constitution, and not upon any difference in the poison itself.

Mr. Hunter believed, that the venereal disease only ceased spontaneously, when it attacked a secreting surface, and produced a mere secretion of pus, without ulceration. Such were some of the sentiments of this great man, who was a firm believer in the identity of the poisons of syphilis and gonorrhœa; but this idea, and the hypothesis about the impossibility of any spontaneous cure of venereal sores, are now mostly relinquished.

The first symptom of gonorrhœa is generally an itching at the orifice of the urethra, sometimes extending over the whole glans. A little fulness of the lips of the urethra, the effect of inflammation, is next observable, and soon afterwards a running appears. The itching changes into pain, more particularly at the time of voiding the urine. There is often no pain till some time after the appearance of the discharge, and other symptoms; and in many gonorrhœas, there is hardly any pain at all, even when the discharge is considerable. At other times, a great degree of soreness occurs long before any discharge appears. There is generally a particular fulness in the penis, and more especially in the glans. The glans has also a kind of transparency, especially near the beginning of the urethra, where the skin being distended, smooth, and red, resembles a ripe cherry. The mouth of the urethra is, in many instances, evidently excoriated. The surface of the glans itself is often in a half-excoriated state, consequently very tender; and it secretes a sort of discharge. The canal of the urethra becomes narrower, which is known by the stream of urine being smaller than common. This proceeds from the fulness of the penis in general, and either from the lining of the urethra being swollen, or in a spasmodic state. The fear of the patient, while voiding his urine, also disposes the urethra to contract; and the stream of urine is generally much scattered and broken, as soon as it leaves the passage. There is frequently some degree of hœmorrhage from the urethra, perhaps, from the distention of the vessels, more especially when there is a chordee, or a tendency to it. Small swellings often occur, along the lower surface of the penis, in the course of the urethra. These Mr. Hunter suspected to be enlarged glands of the passage. They occasionally suppurate, and burst outwardly, but now and then in the urethra itself. Mr. Hunter has also suspected such tumours to be ducts, or lacunæ of the glands of the urethra distended with mucus, in consequence of the mouth of the duct being closed, in a manner similar to what happens to the duct leading from the lachrymal sac to the nose, and so as to induce inflammation, suppuration and ulceration. Hardness and swelling may also occur in the situation of Cowper's glands, and end in considerable abscesses in the perinæum. The latter tumours break either internally or externally, and sometimes in both ways, so as to produce fistulæ in perinæo.

A soreness is often felt all along the under side of the penis, frequently extending as far as the anus. The pain is particularly great in erections; but the case differs from chordee by the penis remaining straight. In most cases of gonorrhœa, erections are frequent, and even sometimes threaten to bring on mortification.

The natural slimy discharge from the glands of the urethra is first changed, from a fine transparent ropy secretion, to a watery whitish fluid; and the lubricating fluid, which the passage naturally exhales, becomes less transparent: both these secretions, becoming gradually thicker, assume more and more the qualities of common pus.

The matter of gonorrhœa often changes its colour and consistence, sometimes from a white to a yellow, and often when the inflammation is severe, to a greenish colour. When the inflammation is very high, shreds of lymph are sometimes discharged with the urine. (*Wallace.*)

These changes depend on the increase and decrease of the inflammation, and not on the poisonous quality of the matter itself; for an irritation of these parts, equal to that produced in a gonorrhœa, will produce the same appearances. Mr. Wallace finds, that the less the inflammatory action, the less alkaline the discharge. (*On Venereal Disease*, p. 244.)

The discharge is produced from the membrane of the urethra, and from the lacunæ, but, in general, only for about two or three inches from the external orifice. Mr. Hunter says, seldom further than an inch and a half, or two inches at most. This he terms the specific extent of the inflammation. Whenever he had an opportunity of examining the urethra affected with gonorrhœa, he always found the lacunæ loaded with matter, and more visible than in the natural state. Before the time of this celebrated man, it was commonly supposed, that the discharge arose from the whole surface of the urethra, and even from Cowper's glands, the prostate, and vesiculæ seminales. But, if the matter were secreted from all these parts, the pus would collect in the bulb, as the semen does, and thence be emitted in jerks; for, nothing can be in the bulbous part of the urethra, without stimulating it to action, especially when in a state of irritation and inflammation.

When the inflammation is violent, some of the vessels of the urethra often burst, and a discharge of blood ensues. Sometimes such blood is only just enough to give the matter a tinge. In other instances, erections cause an extravasation, by stretching the part.

When the inflammation goes more deeply than the membranous lining, and affects the reticular, or spongy structure of the urethra, it produces in it an extravasation of coagulable lymph, the consequence of which is a chordee. (See *Chordee.*)

Mr Hunter suspected that the disease is communicated or creeps along from the glans to the urethra, or, at least, from the lips of the urethra to its inner surface, as it is impossible that the infectious matter can, during coition, get as far as the disease extends. He mentions an instance, in which a gentleman, who had not cohabited with any woman for many weeks, to all appearance caught a gonorrhœa from a piece of plaster, which had adhered to his glans penis, while he was at a privy abroad: the infection is accounted for by supposing, that some person, with a clap, had previously been to the place, and had left behind some of the discharge, and that the above gentleman had allowed his penis to remain in contact with the matter, till it had dried.

Many symptoms, depending on the sympathy of other parts with the urethra, sometimes accompany a gonorrhœa. An uneasiness, partaking of soreness and pain, and a kind of weariness, are felt about every part of the pelvis. The scrotum, testicles, perinæum, anus, and hips, become disagreeably sensible, and the testicles often require to be suspended. So irritable, indeed, are they in such cases, that the least accident, or even exercise, which would have no effect of this kind at another time, will make them swell. The glands of the groin are often affected sympathetically, and even swell, but they do not suppurate, as they generally do when they inflame from the absorption of matter. Mr. Hunter has seen the irritation of a gonorrhœa so extensive, as to render the thighs, buttocks, and abdominal muscles painful. He knew one gentleman, who never had a gonorrhœa without being immediately seized with universal rheumatic pains. Gonorrhœal rheumatism is now recognised as a frequent and a severe complaint.

When the disorder, exclusive of the affections from sympathy, is not more violent than has been described, Mr. Hunter termed it a *common, or simple venereal gonorrhœa*; but, if the patient is very susceptible of such irritation, or of any other mode of action, which may accompany the venereal, then the symptoms are in proportion more violent. In such circumstances, the irritation and inflammation sometimes exceed the specific distance, and extend through the whole urethra. There is often a considerable degree of pain in the perinæum; and a frequent, though not a constant, symptom, is a spasmodic contraction of the acceleratores urinæ, and erectores muscles. In these cases, the inflammation is sometimes considerable, and goes deeply into the cellular tissue, but without producing any effect, except swelling. In other instances, it goes on to suppuration, often becoming one of the causes of fistulæ in perinæo. Thus, Cowper's glands may suppurate, and the irritation often extends even to the bladder itself.

When the bladder is affected, it becomes more susceptible of every kind of irritation. It will not bear the usual distention, and, therefore, the patient cannot retain his water the ordinary time; and, the moment the desire of making water takes place, he is obliged instantly to make it, with violent pain in the bladder, and still more in the glans penis, exactly similar to what happens in a fit of the stone. If the bladder be not allowed to discharge its contents immediately, the pain becomes almost intolerable; and even when the water is evacuated, there remains, for some time, a considerable pain, both in the bladder and glans.

Sometimes, though rarely, when the bladder is much affected, the ureters, and even the kidneys sympathise; and Mr. Hunter had reason to suspect, that the irritation might be communicated to the peritonæum, by means of the vas deferens.

Mr. Hunter mentions a case, in which, while the inflammatory symptoms of a gonorrhœa were abating, an incontinence of urine came on; but, in time, spontaneously subsided.

A very common symptom attending a gonorrhœa, is a swelling of the testicle. (See HERNIA HUMORALIS, and TESTICLE.)

Another occasional consequence is a sympathetic swelling of the inguinal glands. (See BUBO.)

A hard chord is sometimes observed, leading from the prepuce along the back of the penis, and often directing its course to one of the groins, and affecting the glands. At the part of the prepuce where the chord takes its rise, there is most commonly a swelling. This sometimes happens when an excoriation and a discharge from the prepuce, or glans penis, exist. In one case, Mr. Howship suspected the large vein on the dorsum of the penis to be inflamed and thickened. (*On Complaints affecting the Secretion and Excretion of the Urine, &c.* p. 266.)

Thus, the symptoms of gonorrhœa, in different cases, seem to be subject to infinite variety. The discharge often appears without any pain; and the coming on of the pain is not at any stated time after the appearance of the discharge. There is often no pain at all, although the discharge is in considerable quantity, and of a bad appearance. The pain often goes off, while the discharge continues, and will return again. In some cases, an itching is felt for a considerable time, which is sometimes succeeded by pain; though, in many cases, it continues till the end of the disease. On the other hand, the pain is often troublesome, and considerable, even when there is little or no discharge. The neighbouring parts sympathize, as the glands of the groin, the testicle, the loins and pubes, the upper parts of the thighs, and the abdominal muscles. Sometimes the disease appears a few hours after the application of the poison; sometimes not till six weeks have elapsed. Lastly, it is often impossible to determine, whether the case is a venereal discharge, or rather one produced by the application of infectious matter, or only an accidental discharge, arising from some unknown cause.

GONORRHŒA IN WOMEN.

Gonorrhœa in women is a much less painful complaint than in men, and less subject to complications, as bubo, retention of urine, &c. The complaint may not generally prevent the patient from following her usual occupations, and the menses are as little affected by it, as it is by them.

The disorder is not so easily ascertained in them as in men, because they are subject to a disorder called *fluor albus*, or *leucorrhœa*, which resembles gonorrhœa. A mere discharge in women, is less a proof of the existence of a gonorrhœa, than even a discharge without pain in men. The kind of matter does not enable us to distinguish a gonorrhœa from a fluor albus; for, in the latter affection, the discharge often puts on all the appearance of pus. Pain is not necessarily present, and therefore forms no line of distinction. The appearance of the parts often gives us but little information; "for," says Mr. Hunter, "I have frequently examined the parts of those who confessed all the symptoms, such as increase of discharge, pain in making water, soreness in walking, or when the parts were touched, yet I could see no difference between these and sound parts. I know of no other way of judging, in cases where there are no symptoms sensible to the person herself, or where the patient has a mind to deny any uncommon symptoms, but from the circumstances preceding the discharge; such as her having been connected with men supposed to be unsound, or her being able to give the disorder to others; which last circumstance, being derived from the testimony of another person, is not always to be trusted to, for obvious reasons." But, though there may sometimes be great difficulty in forming a judgment of some of these cases, the surgeon may frequently come to a right conclusion by recollecting, as Mr. Dunn has reminded me, that, besides the difference depending on the suddenly severe symptoms of gonorrhœa, fluor albus may be known by the great debility; the sinking of the stomach; the weariness of the limbs; the pain of the back, always increased by the erect posture; the severe headachs; the painful menstruation, together with the very gradual increase of the disease.

From the manner in which the disease is contracted, it must principally attack the vagina, a part not endowed with much sensation. In many cases, however, it produces a considerable soreness on the inside of the labiæ, nymphæ, clitoris, carunculæ myrtiformes, and meatus urinarius. In certain cases, these parts are so sore, that they will not bear to be touched; the person can hardly walk; the urine gives pain in its passage through the urethra, and when it comes into contact with the above-mentioned parts.

The bladder, and even the kidneys, occasionally sympathize. The mucous glands on the inside of the labia often swell, and sometimes suppurate, forming small abscesses, which open near the orifice of the vagina.

According to Mr. Hunter, the venereal matter from the vagina sometimes runs down the perinæum to the anus, and produces a purulent discharge, or even ulceration, in that situation. The disease in women may wear itself out, as in men; but it may exist in the vagina for years, if the testimony of patients can be relied on.

TREATMENT OF GONORRHŒA.

As Mr. Hunter supposed, that every form of the venereal disease arose from the same cause, and we have a specific for some forms, that it might be conceived or expected, this would be a certain cure for every one; and, therefore, that it must be no difficult task to cure the disease, when in the form of inflammation and suppuration in the urethra. Experience teaches us, however, that gonorrhœa is the most variable in its symptoms, while under a cure; and the most uncertain, with respect to its cure, of any forms of the venereal disease (if it ever be a form of this disease at all), many cases terminating in a week, while others continue for months under the same treatment.

Whatever differences of opinion may be entertained respecting the cause of gonorrhœa, and particularly with regard to its being excited by the influence of the venereal poison, its inflammatory nature cannot be overlooked; and it is this character of the disorder, which determines, in a great measure, the plan of treatment. The great indication, however, insisted upon by Mr. Hunter, was that of destroying the disposition and specific mode of action in the solids of the parts, and as they become changed, the poisonous quality of the matter produced will also be destroyed. This effects the cure of the disease, but does not always remove the consequence.

Gonorrhœa is incapable of being continued beyond a certain time in any constitution; and, when it is violent, or of long duration, it is owing to the part being very susceptible of such irritation, and readily retaining it. As no specific remedy for gonorrhœa is known, it is fortunate that time alone will effect a cure. Mr. Hunter was inclined to think medicine not of the least use, in nine cases out of ten. But even this would be of some consequence, if the cases, capable of being benefited, could be distinguished. Surgeons of the present day, however, have less despondency on this subject, than the distinguished man, whose opinion I have just now cited.

The means of cure, generally adopted, are of two kinds, internal remedies, and local applications; but, whatever plan is pursued, Mr. Hunter inculcates the doctrine, that we are always to attend more to the nature of the constitution, or to any accompanying disease in the parts themselves, or parts connected with them, than to the gonorrhœa itself.

When the symptoms are of the common inflammatory kind, known by the extent of the inflammation not exceeding the specific distance, Mr. Hunter found irritating applications less dangerous, than when irritable inflammation is present: they seemed to him capable of altering the specific action; but, to produce this effect, their irritation must be greater than that of the original injury; and, as M.M. Cullerier and Ratier observe, they must be tried at the very beginning of the case. The parts will afterwards recover of themselves, as from any other common inflammation.

Mr. Hunter believes, however, that in the beginning the soothing plan is generally the best. If the inflammation be great, and of the irritable kind, no violence is to be used, for it would only increase the symptoms; and he states, that nothing should be done that can tend to stop the discharge, as it would not put a stop to the inflammation.

But, if the disease has begun mildly, an irritating injection may be used, in order quickly to get rid of the specific mode of action. This application will increase the symptoms for a time; but, when it is left off, they will often abate, or wholly disappear; and, after such abatement, astringents may be used, the discharge being the only thing to be removed.

When itching, pain, and other uncommon sensations are felt for some time before the discharge appears, Mr. Hunter diffidently expresses his inclination to recommend the soothing plan, instead of the irritating one, in order to bring on the discharge, which is a step towards the resolution of the irritation; and he adds, that to use astringents would be bad practice, as, by retarding the discharge, they would only protract the cure. When there are strictures or swelled testicles, astringents should not be used; for, while there is a discharge, such complaints are relieved.

Mr. Hunter thus expresses himself in regard to the effect of mercury in gonorrhœa: "I doubt very much of mercury having any specific virtue in this species of the disease; for I find that it is as soon cured without mercury as with it, &c. So little effect, indeed, has this medicine upon a gonorrhœa, that I have known a gonorrhœa take place (while the patient was) under a course of mercury, sufficient for the cure of a chancre. Men have also been known to contract a gonorrhœa when loaded with mercury for the cure of a lues venerea; the gonorrhœa, nevertheless, has been as difficult of cure as in ordinary cases."

Mr. Hunter does not say much in favour of evacuants, diuretics, and astringents, given internally. He allows, however, that astringents, which act specifically on the parts, as the balsams, conjoined with any other medicine, which may be thought right, may help to lessen the discharge, in proportion as the inflammation abates.

Local applications may be either internal to the urethra, external to the penis, or both. Those which are applied to the urethra seem to promise most efficacy, because they come into immediate contact with the diseased parts. They may be either in a solid or fluid form. A fluid is only a very temporary application. The solid ones, or bougies, may remain a long while, but in general irritate immediately, from their solidity alone; and Mr. Hunter says, the less bougies are used when the parts are in an inflamed state, the better. At present, bougies are rarely used in gonorrhœa, in consequence of their tendency to bring on a swelling of the testes.

The fluid applications, or injections, in use, are innumerable, and gonorrhœa frequently gets well with many of various kinds. They often have an immediate effect on the symptoms, and hence must have power; though the injection which possesses the greatest power is unknown. As injections are only temporary applications, they must be used often, especially when found useful, and not of an irritating kind.

Mr. Hunter divides injections into four kinds, the *irritating*, *sedative*, *emollient*, and *astringent*. According to his doctrines, irritating injections of every kind, act in this disease upon the same principle; that is, by producing an irritation of another kind, which ought to be greater than the venereal; by which means the venereal is destroyed and lost, and the disease cured, although the pain and discharge may still be kept up by the injection; effects, however, which will soon go off, when the injection is laid aside. In this way bougies also perform a cure. Most of the irritating injections have an astringent effect.

Irritating injections should never be used when there is considerable inflammation present; especially in constitutions which are known to be incapable of bearing much irritation; nor should they be used when the inflammation has spread beyond the specific distance; nor when the testicles are tender; nor when, upon the discharge ceasing quickly, these parts have become sore; nor when the perinæum is very susceptible of inflammation, and especially if it formerly should have suppurated; nor when there is a tendency in the bladder to irritation, known by the frequency of making water.

In mild cases, and in constitutions which are not irritable, such injections often succeed, and remove the disease almost immediately. The practice, however, ought to be attempted with caution, and not, perhaps, till milder methods have failed. Two grains of the hydrargyrus muriatus, dissolved in eight ounces of distilled water, form a very good irritating injection; but an injection of only half this strength may be used, when it is not intended to attempt a cure so quickly. If, however, the injection, even in that proportion, gives considerable pain in its application, or occasions a great increase of pain in making water, it should be further diluted.

Sedative injections will always be of service, when the inflammation is considerable, and they are very useful in relieving the pain. Perhaps, the best sedative is opium, as well when given by the mouth, or anus, as when applied to the part affected, in the form of an injection. But, even opium will not act as a sedative in all constitutions and parts; but, on the contrary, often has opposite effects, producing great irritability. Lead may be reckoned a sedative, so far as it abates inflammation, while, at the same time, it acts as a gentle astringent. Fourteen grains of acetate of lead, in ℥viij of distilled water, make a good sedative astringent injection.

Drinking freely of diluting liquors may have a sedative effect, as it in part removes some of the causes of irritation, by rendering the urine less stimulating to the bladder, when the irritation is there, and to the urethra in its passage through it. The vegetable mucilages of certain seeds and plants, and the emollient gums, are recommended. Mr. Hunter does not entertain much opinion of their efficacy, though some of his patients told him, that they experienced less uneasiness in making water, when their drink was impregnated with mucilaginous substances.

Emollient injections are the most proper, when the inflammation is very severe; and they probably act by first simply washing away the matter, and then leaving a soft application to the part, so as to be singularly serviceable, by lessening the irritating effects of the urine. Indeed, practice proves this; for a solution of gum arabic, milk and water, or sweet oil, will often lessen the pain, and other symptoms.

The irritation at the orifice of the urethra is frequently so great, that the point of the syringe cannot be suffered to enter. In this case, no injection should be used till the inflammation has abated; but, in the meanwhile, fomentations may be employed.

Astringent injections act by lessening the discharge. They should only be used towards the latter end of the disease, and when it has become mild. But if the disease should begin mildly, they may be used at the very beginning; for, by gradually lessening the discharge, without increasing the inflammation, we complete the cure, and prevent a continuance of the discharge called *gleet.*

The apprehension, that injections give a tendency to hernia humoralis, and strictures, has lessened very much the frequency of their use at the present day, though it is to be suspected, with regard to strictures, that the long continuance of the discharge will be more likely than the injection, to produce them. This opinion has been entertained by many good and experienced practitioners, and I observe that it is professed by Mr. Wallace. (*On Ven. Dis.* p. 251.) While much sensibility exists, this gentleman prefers an injection, composed of 15 grs. of nitrate of silver to an ounce of water. When the sensibility has been lessened, he uses an injection of half a grain of muriate of mercury to an ounceof water; or a grain and a half of the sulphate of copper, or acetate of zinc.

On the principle of gonorrhœa being manifestly an inflammatory disorder, it is at first mostly treated, at the present day, by antiphlogistic means. In this country, however, we rarely take blood from the arm, unless the complications of the case require it, as may happen when the inflammation exceeds the specific distance, retention of urine comes on, or inflammation of the testicle occurs. In severe cases, leeches may be applied to the perinæum; and the patient use the warm bath, hip bath, or bidet, under the influence of which he will be able to discharge his urine without pain, or difficulty. If there exists a state of active inflammation, Mr. Wallace applies leeches to the perinæum, or to the body of the penis, or to the internal surface of the prepuce, or to the glans in the neighbourhood of the frænum. "The leech-bites may be covered with a cataplasm, and allowed to bleed as long as convenient. When we wish to stop the bleeding, this may be done by touching the wounds made by the leeches with a pointed piece of nitrate of silver. Any ecchymosis, produced in the penis or scrotum, by the application of leeches, quickly disappears." If the patient prefers it, Mr. Wallace sanctions puncturing one or more of the veins on the dorsum penis. (See *Wallace on Ven. Dis.* p. 247.) If any distress continue, after the antiphlogistic treatment has been persisted in for a day or two, he observes, that the greatest advantage will be derived from full doses of opium and henbane, combined with calomel. In the intervals between the periods of using the warm bath, the penis, scrotum, and perinæum, should be fomented with a decoction of poppy heads. The bowels are to be kept open; a stimulating diet avoided; and mucilaginous diluent beverages taken freely, with the view of rendering the secretion of the urine more abundant, and its quality less irritating to the urethra.

Many modern surgeons have relinquished the use of all injections in the treatment of gonorrhœa, and manage the disease on common antiphlogistic principles. Mr. Howship states, that when injections are used, they are not unfrequently followed by a most distressing and permanent irritability of the bladder. (*On Complaints affecting the Se.*

cretion and Excretion of the Urine, p. 268.) But, the common objection to them is founded upon the suspicion, that they increase the frequency of hernia humoralis, and strictures.

Since Mr. Hunter's time, many surgeons have been in the habit of keeping the penis in the incipient inflammatory stage of gonorrhœa, covered with linen, continually wet with the liquor plumbi acetatis dilutus; a practice which is certainly both rational and beneficial. Mr. Abernethy, in his *Lectures on Surgery*, speaks in favour of this method. And some surgeons, amongst whom is my intelligent correspondent, Mr. Dunn, of Scarborough, have seen great relief derived from the use of a suspensor scroti, or double handkerchief, which, combined with rest and the elevation of the penis, the last-mentioned practitioner has frequently found, indeed, of more service than any thing else. A suspensory bandage is believed to lessen the chance of the testicles being attacked by inflammation.

For the relief of the ardor urinæ, and irritable state of the bladder in gonorrhœa, opium, camphor, conium, and hyosciamus, have been extensively employed. Sir Benjamin Brodie informs me, that when the disease is attended with chordee, the vinum colchici frequently has beneficial effects. In consequence of this information, I have sometimes prescribed the vinum colchici, and found it useful in relieving the strangury, ardor urinæ, and irritable state of the bladder.

In the treatment of gonorrhœa, the liquor potassæ is a favourite internal medicine with many practitioners, who begin with prescribing it, and continue its use until the inflammatory stage has subsided. However, according to Mr. Howship, its effects are uncertain, and sometimes it excites uneasiness and irritation about the neck of the bladder, and difficulty of voiding the urine. Hence, whenever he directs this medicine, it is in combination with some aperient, so that it may not remain long in the bowels. (*On Complaints affecting the Secretion and Excretion of the Urine*, p. 269.)

When the glands of the urethra are enlarged, mercurial ointment, or that of the hydriodate of potash, may be rubbed on them, after the inflammation has subsided.

Treatment of Gonorrhœa in Women.

This is nearly the same as that of the disease in men, but is more simple. When the disorder is in the vagina, injections are best; and after their use, the external parts should be well washed. It is almost impossible for the patient to throw an injection into the urethra, when it is affected. The same injections are proper as for men; but they may be made doubly strong. When the glands of the vagina suppurate, and form abscesses, these should be opened and dressed; but the practice of smearing the parts with mercurial ointment, as advised by Mr. Hunter, is now entirely abandoned.

Constitutional Treatment of Gonorrhœa.

In many strong plethoric constitutions, the symptoms are violent, and there is a great tendency to inflammatory fever. In such instances, opiate clysters, though at first productive of relief, sometimes increase the fever, and consequently aggravate all the symptoms. In these cases, the balsam of capivi, also, sometimes increases the inflammatory symptoms. In a constitution of this kind, the treatment consists chiefly in evacuations, the best of which are bleeding, and gentle purging. The patient must live sparingly, and above all, use little exercise.

In a weak and irritable constitution, the symptoms are frequently violent, the inflammation extending beyond the specific distance, running along the urethra, and even affecting the bladder. Here the indication is to strengthen; and, according to Mr. Hunter, bark alone has been known to effect a cure. All evacuations are hurtful.

A fever has been known to stop the discharge, relieve the pain in making water, and finally cure the disease. On other occasions, Mr. Hunter has seen all the symptoms of gonorrhœa cease on the accession of a fever, and return when the fever was subdued. In other examples, a gonorrhœa, mild at first, has been rendered severe by the coming on of a fever, and, upon its subsidence, the gonorrhœa has ceased. Although a fever does not always cure a gonorrhœa, yet, as it may do so, nothing should be done while it lasts. If the local complaint should continue after the fever is gone, it is to be treated according to symptoms.

A gonorrhœa may be considerably affected by the patient's manner of living, and by other diseases attacking the constitution. Most things which hurry or increase the circulation, aggravate the symptoms; such as violent exercise, drinking strong liquors, eating high-seasoned, indigestible food, some kinds of which act specifically on the urethra, so as to increase the symptoms more than simply heating the body would do; such as pepper, spices in general, and spirits.

In cases which have begun mildly, and in which the inflammation is only slight, or in others, in which the violent symptoms have subsided, such medicines as have a tendency to lessen the discharge, may be given, together with the local remedies before mentioned. Turpentines are the most efficacious, particularly the balsam of capivi, and cubebs. (See *Edin. Med. and Surgical Journ. for January*, 1818, *and for the same month*, 1819; also, *H. Jeffery's Pract. Obs. on Cubebs*, 8vo. Lond. 1821.) Of the latter medicine ʒ ij may be given thrice in the 24 hours; but with respect to these and all other medicines, which act upon the disease through the medium of the urine, if they succeed at all, it is always within a week or ten days from the beginning of their use; and, therefore, if no amendment take place in this time, they should not be continued. Cantharides, the salts of lead and copper, and alum, have also been recommended.

The opinions entertained by Mr. Hunter, respecting the identity of the infection of gonorrhœa, and that of the venereal disease, led him to prescribe small doses of mercury, in consequence of the possibility of absorption, and with the view of preventing lues venerea.

Treatment of some occasional Effects of Gonorrhœa.

Bleeding from the Urethra is sometimes relieved by the balsam capivi. Mr. Hunter did not find astringent injections of use. Ice-cold water, applied to the penis, scrotum, and perinæum, is one of the best expedients.

Painful Erections are greatly prevented by taking twenty drops of tinctura opii, or half a drachm of vinum colchici, at bedtime. Hemlock has also some power in this way; and many surgeons, among whom is Mr. Dunn, of Scarborough, have a favourable opinion of camphorated poultices, and of the internal exhibition of camphor.

Chordee. See this word.

Bladder affected. Opiate clysters, the warm bath, and bleeding, if the patient is of full habit, are proper. The excellent effects of the vinum colchici, as stated to me by Sir Benjamin Brodie, I have already noticed. Leeches may be applied to the perinæum. When this affection lasts a considerable time, and is not mitigated by common methods, Mr. Hunter advises trying an opiate plaster on the pubes, or the loins, where the nerves of the bladder originate; or a small blister on the perinæum. A belladonna plaster would probably act more powerfully than one of opium. In another place, he mentions bark, hemlock, sea-air, and sea-bathing, among the proper means.

Swelled Testicle. See HERNIA HUMORALIS.

Retention of Urine. See URINE, RETENTION OF.

ON THE QUESTION, WHETHER GONORRHŒA IS REALLY A FORM OF THE VENEREAL DISEASE.

Mr. Hunter believed, that the poison of gonorrhœa and the venereal virus were the same. He had seen all the symptoms of lues venerea originate from gonorrhœa only; he assures us, that he had even produced venereal chancres by inoculating with the matter of gonorrhœa; and that he had repeated the experiment in a manner in which he could not be deceived. (p. 293, *et seq.*)

Mr. Hunter's experiments, it is true, have been repeated with a different result; but, as one of his advocates has remarked, can we wonder at this, when we consider from how many causes gonorrhœa may arise, and how impossible it is to distinguish the venereal from any other? (*Obs. on Morbid Poisons, by J. Adams, M. D.* p. 91. ed. 2.)

Another argument, adduced by Hunter, in favour of the poisons of gonorrhœa and chancre being the same, is the probability that the Otaheiteans, had the venereal disease propagated to them by European sailors, who were affected with gonorrhœa; for these can hardly be supposed to have had a chancre, during a voyage of five months without the penis being destroyed. It is impossible, however, to say what time may elapse between the application of the venereal poison to the penis, and the commencenent of the ulceration. Therefore, Bougainville's sailors alluded to by Mr. Hunter, might have contracted the infection at Rio de la Plata; but some of the primary ulcers might still have remained unhealed when the ship arrived at Otaheite. But this argument adduced by Mr. Hunter is founded not upon any certain information respecting the origin of the disease in Otaheite, and it implies what is now very commonly disbelieved, viz. that syphilis had only a single commencement in Italy, America, or some other part of the world, from which it has been extended to all other countries. Instead of this doctrine, there is great reason to think, that the disease has had an infinite number of original sources, or beginnings.

In attempting to explain why a gonorrhœa, and a chancre do not equally produce lues venerea, and why the medicine which almost universally cures chancre, has less effect on gonorrhœa, one believer in Mr. Hunter's doctrine says, that we must take into consideration, that the seat of the two diseases is different; that the same cause may produce different effects upon different parts; that the same poison, when mixed with different fluids, may be more or less violent in its operation; and that there may be greater or less attraction of certain fluids to a part, according to its nature and composition. (*Inquiry into some Effects of the Venereal Poison, by S. Sawrey,* 1802. p. 4.) Mr. Sawrey truly remarks, p. 6. that, if the gonorrhœal matter has clearly and decidedly produced chancre, or contaminated the system *in any one instance,* the question is determined. It could in no instance produce these effects unless it had the power of doing so. This writer brings forward some cases to prove, that the poison of gonorrhœa may produce gonorrhœa or chancre; but the limits of this work, only afford room to observe, that these instances are by no means decisive of the point, because some objections may be urged against them, as, indeed, Mr. Sawrey himself allows.

Why does not gonorrhœa commonly produce ulceration in the urethra? Mr. Sawrey tries to solve this question, by saying, that the product of the venereal inflammation, the diseased contents of the small arteries of the urethra, are thrown out of these open-mouthed vessels into this canal, without any breach of their texture, which otherwise would be a necessary consequence.

Why does not gonorrhœa equally contaminate the system as chancre? In gonorrhœa, says Mr. Sawrey, the discharge is very plentiful; it is not, in general, attended with ulceration; the poison is much more diluted, and mixed with a mucous and puriform fluid. It is deposited in the urethra, and its lacunæ, where little or no pressure is applied, and it finds easy egress out of the canal. In chancre, there is breach of substance, the poison is not much diluted, &c.

Why does not chancre generally in the same person produce gonorrhœa, and gonorrhœa, chancre? Mr. Sawrey, in answer, expresses his belief, that these incidents are not very unfrequent. He says, he has known persons having a chancre, which continued for months, become affected, after that time, with a clap, without any further exposure. His opinion is, that the matter of the chancre had insinuated itself into the urethra, and produced the disease; though he confesses, many would explain the circumstance, by supposing that the chancre and gonorrhœa were both communicated at the same time by two different poisons.

Mr. Hunter conceives, that the presence of one disease renders the adjacent parts less susceptible of the influence of the other.

Another defender of this side of the question is Dr. Swediaur, who endeavours to prove the fallacy of the following positions: 1. *That the poison which produces the clap does never, like that of chancres, produce any venereal symptoms in the mass or lues itself.* 2. *That the poison of the clap never produces chancres, and that the poison of chancres never produces a clap.* 3. *That mercury never contributes to, nor accelerates, the cure of a* *clap; but that, on the contrary, every blennorrhagia may be certainly cured without mercury, and without any danger of leaving a lues behind.*

His arguments run thus:—the reason why claps do not, like chancres, constantly produce lues, is, that most of them excite only a superficial inflammation in the membrane of the urethra, without any ulceration. Hence, absorption cannot easily take place, the poison being out of the course of the circulation. But he has seen claps, with an ulcer in the urethra, followed by the most unequivocal symptoms of lues itself. He mentions the urethra being defended with a large quantity of mucus, as the thing impeding the common formation of ulcers, which do occasionally occur when the mucus is not secreted as usual, or is washed away. He asserts, that in many cases, where he had occasion to examine both parties, he was convinced that the chancres were communicated by a person affected with a simple gonorrhœa; and *vice versa*, that a virulent clap had been the consequence of an infection from a person having merely chancres. He says, that if a patient, with a venereal running, does not take care to keep the prepuce and glans perfectly clean, chancres will very often be produced. He owns, that a great many claps are cured without mercury; yet, repeated experience has shown him, a cure cannot always be thus accomplished. Mild cases, without ulcer or excoriation in the urethra, may certainly be radically cured without a grain of mercury; and though mercury should be given, it would not have the least effect; not because the disease does not proceed from the venereal poison, but because it is out of the course of the circulation. He contends, that the topical use of mercury in injections acts usefully even in these cases. But, when a clap is joined with ulceration in the urethra, it is always cured more safely and expeditiously with mercury, and is frequently incurable without it. A lues also follows cases attended with ulcers in the urethra. He allows, that all claps are not venereal. (See *Pract. Obs. on Venereal Complaints, by J. Swediaur.*)

One argument urged against the identity of gonorrhœal and chancrous virus, is, that gonorrhœa was not described as a symptom, till nearly half a century after the other symptoms of the venereal disease were known. Fallopius is among the first who observed gonorrhœa, as a symptom of the venereal disease. "If, however," says Dr. Adams, "venereal gonorrhœa was unnoticed till about fifty years after the other forms of the disease were described, what does this prove, but that contagious gonorrhœa was so common, as to be disregarded as a symptom of the new complaint? Can there be a doubt, from the caution given by Moses, that gonorrhœa was considered as contagious in his days? During the classical age, we find inconveniences of the urinary passages were imputed to incontinence; and the police of several states, before the siege of Naples, made laws for preserving the health of such as would content themselves with public stews, instead of disturbing the peace of families.

"This is enough to lessen our surprise, that gonorrhœa should be unnoticed for some time after the appearance of the venereal disease. But, so far is it from proving, that the two contagions are different, that the fairest inference we can draw is in favour of their identity. For, if by this time the venereal disease began to be so far understood, that secondary symptoms were found the consequence of primary ones in the genitals, it is most probable, that the first suspicion of venereal gonorrhœa arose from the occurrence of such secondary appearances, where no other primary symptoms could be traced." (*Adams on Morbid Poisons*, p. 95. ed. 2.)

The sentiments of Mr. B. Bell are quite at variance with those of Hunter, Sawrey, Swediaur, Adams, &c.; but, my limits will only allow me to enumerate a few of his leading arguments.

If the matter of gonorrhœa, and that of chancre, were of the same nature, we must admit, that a person with a chancre only, can communicate to another, not only every symptom of pox, but of gonorrhœa; and that another, with gonorrhœa only, can give to all, with whom he may have connexion, chancres, with their various consequences. This ought indeed to be a very frequent occurrence; whereas, all allow that it is even in appearance very rare.

On the supposition of the matter of gonorrhœa and lues venerea being the same, the latter ought to be a much more frequent occurrence than the former, from the greater ease with which the matter of infection must, in every instance, be applied to those parts on which it can produce chancres, than that of the urethra, where, instead of chancre or ulceration, it almost always excites gonorrhœa. It is difficult to conceive how the matter, by which the disease is communicated, should find access to the urethra; while all the external parts of the penis, particularly the glans, must be easily, and universally exposed to it; and yet gonorrhœa is a much more frequent disease than pox. Cases of gonorrhœa are in proportion to those of chancre, according to Mr. B. Bell's experience, as three to one. It is obvious, that the very reverse should happen, if the two diseases were produced by the same kind of matter.

The grand practical consideration, depending on the possibility of the venereal disease arising from gonorrhœa, is, whether mercurials should not be exhibited, in all cases, with the view of preventing such a consequence.

Waving, on my own part, all attempts to decide the point, whether the matter of a chancre, and that of one species of gonorrhœa, are of the same nature, I shall merely content myself with stating, that so far as my observation and inquiries extend, the majority of the best practitioners consider the exhibition of mercury unnecessary, and consequently improper in gonorrhœa. This fact almost amounts to a proof that, if venereal symptoms do ever follow a clap, they are so rare, and I may add, always so imputable to other causes, that the employment of mercury, as a preventive, would, upon the whole, do more injury, than benefit to mankind; and this, even admitting (what, in my mind, has never been unequivocally proved) that the matter of gonorhœa is really capable, in a very few instances, of giving rise to the venereal disease. However, a few surgeons will not yet altogether renounce the employment of mercury in gonorrhœa. Thus, Mr. Wallace gives small doses of it, with copaiva, or cubebs, after the active inflammation has subsided. (See *Wallace on Ven. Dis.* p. 248.)

Mr. Carmichael, who is a believer in a plurality of venereal poisons, inculcates the doctrine, that what he terms the *papular venereal disease*, or that which is characterized by a papular eruption, if the skin become affected, originates from a peculiar virus, which gives rise to gonorrhœa, and which is different from poisons supposed by him to excite other forms of the venereal disease. As, however, the simple primary ulcer, excoriation and gonorrhœa very frequently exist together, Mr. Carmichael suspects, that they all arise from the same identical poison. (See *Essay on Ven. Dis.* p. 76. ed. 2. 8vo. *Lond.* 1825.) At the same time, this gentleman concurs in the common belief, that constitutional symptoms after a gonorrhœa, are very rare. With regard to Mr. Carmichael's views, several facts present themselves. 1. The formation of excoriations and simple sores does not necessarily require the influence of any poison. 2. Sores, capable of imparting every form of constitutional syphilis, are now frequently believed by men of great experience, to present themselves in the form of simple ulcers. 3. Numerous surgeons would ascribe the constitutional symptoms, which, in a small proportion of cases, follow gonorrhœa to the existence of venereal ulceration together with this disease, or, at some period before or after it. 4. The facts that primary venereal sores of every description are capable of healing up spontaneously, and that some of them, being small and superficial, and therefore disregarded, and allowed thus to heal, are considerations which interfere considerably with some of Mr. Carmichael's ingenious conclusions. However, if it were proved, that constitutional symptoms of a peculiar kind, like those specified by Mr. Carmichael, were limited to gonorrhœal cases, then there would be reason for suspecting that their nature must be determined by the influence of a poison, not corresponding to that of other forms of the venereal disease.

J. Andrée, on the Theory and Cure of the Venereal Gonorrhœa, and the Diseases which happen in consequence of that Disorder, 8vo. Lond. 1777. *J. Nevill*, A Description of the Venereal Gonorrhœa, 8vo. Lond. 1754. *J. Clubbe*, An Essay on the Gonorrhœa Virulenta, in which the different Opinions respecting the Treatment of the Disease are carefully examined, &c. 8vo. Lond. 1786. *W. Thomas*, An Essay on Gonorrhœa, with some Obs. on the Use of Opium, 8vo. Lond. 1780. *John Hunter*, A Treatise on the Venereal Disease, 4to. 1788. *W. Rowley*, The most cogent Reasons why astringent Injections, &c. should be banished, &c. 8vo. Lond. 1800. *J. H. G. Schleget*, Versuch einer Geschichte des Streites über die Identität des Venus und Trippergiftes, 12mo. Jenæ, 1796. *Whately*, on the Gonorrhœa Virulenta, 8vo. Lond. 1801. Pract. Obs. on Venereal Complaints, by *F. Swediaur*, M. D., ed. 3. An Inquiry into some of the Effects of the Venereal Poison, by *S. Sawrey*, 1802. Obs. on Morbid Poisons, by *J. Adams*, M. D., edit. 2. 1807. *J. C. Jacobs*, Démonstration de l'Identité des Virus de Vérole et de la Gonorrhée, 8vo. Bruxelles, 1811. *J. F. Hernandez*, Essai Analytique sur la Non-identité des Virus Gonorrhoique et Syphilitique, 8vo. Toulon, 1812. *R. Carmichael*, Essays on the Venereal Diseases which have been confounded with Syphilis, &c. 4to. Lond. 1814; and his Obs. on the Symptoms and Specific Distinctions of Venereal Diseases, 8vo. Lond. 1818. *John Howship*, On Complaints affecting the Secretion and Excretion of the Urine, 8vo. Lond. 1823. *M. M. Cullerier* et *Ratier*, in Dict. de Méd. et de Chir. Pratiques, art. Blennorrhagie. *W. Wallace*, On the Venereal Disease and its Varieties, chap. vi. 8vo. Lond. 1833.

GORGET. An instrument, used in the operation of lithotomy, for the purpose of cutting the prostate gland and neck of the bladder, so as to enable the operator to introduce the forceps and extract the stone. It is, in fact, a sort of knife, at the end of which is a beak, that fits the groove of the staff, and admits of being pushed along it into the bladder. Besides cutting gorgets, constructed for the preceding design, there are also blunt ones, intended to be introduced into the wound, their concavity then serving as a guide for the forceps into the bladder.

GRANULATIONS. The little conical eminences, which form on the surfaces of ulcers, and suppurating wounds, and serve for filling up the cavities, and bringing nearer together and uniting the margins of ulcers and wounds, healing by what is termed the *second intention*. They receive their name from their granular appearance.

We must here consider the operations of nature, in bringing parts as nearly as possible to their original state, whose disposition, action, and structure have been altered by accident, or disease. Having formed pus, she immediately begins to form a new substance upon surfaces in which there has been a breach of continuity. This is called the *granulating process*, or *incarnation*; and the substance formed, *granulations*.

Granulations are an accretion of animal matter upon the wounded or exposed surface; they are formed by an exudation of coagulating lymph or fibrin, into which blood extends from the subjacent vessels; and these vessels, communicating with the latter, are soon formed in it, so as to render it organised. This substance was analysed in 1822 by Dr. John Davy, who ascertained its fibrinous nature; and it has since been chemically investigated by M. M. Dupuy and Lassaigne, who arrived at the same conclusion. Granulations are extremely vascular; indeed, more so than almost any other animal substance. "That this is the case (says Mr. Hunter) is seen in sores every day. I have often been able to trace the growth and vascularity of this new substance. I have seen upon a sore a white substance exactly similar, in every visible respect, to coagulating lymph. I have not attempted to wipe it off, and the next day of dressing, I have found this very substance vascular; for, by wiping, or touching it with a probe, it has bled freely. I have observed the same appearance on the surface of a bone that has been laid bare. I once scraped off some of the external surface of a bone of the foot, to see if the surface would granulate. I remarked, the following day, that the surface of the bone was covered with a whitish substance, having a tinge of blue. When I passed my probe into it, I did not feel the bone bare, but only its resistance. I conceived this substance to be coagulable lymph, thrown out from inflammation, and that it would be forced off when suppuration came on; but on the succeeding day, I found it vascular, and appearing like healthy granulations." Mr. J. W. Earle, in his inquiry into the nature of inflammation, gives the following explanation of the formation of granulations. "When the globules of the blood have been effused on the surface of a wound, it is clear that, after a time, their continued passage will have established an immense number of furrows, or canals, in that which was at first merely an amorphous layer, or covering of fibrin, which canals must be the continuations of the genuine capillaries and which, like them, must be wholly unprovided with distinct coats, like larger vessels. In proportion as these channels become established, the fibrinous layer is no longer in its original condition, but is pierced by innumerable perforations, which offer a readier egress to the serum and fibrin, as well as to the globules, so that at length, nearly the whole of the discharge from the surface of a wound, may find its way through them directly, instead of, as previously, by percolation, As the fresh fibrin exudes through the original layer by these channels, or perforations, it will coagulate around them in little heaps, whose central points must be the channels, or continuations of the genuine capillaries, through which it had exuded. As, on the one hand, the colouring matter of the globules was lost, in proportion to the difficulty with which they were forced by the pressure of the *vis a tergo*, through the parenchyma and fibrin, as yet imperforate; so, on the other hand, in proportion now as their passage is facilitated by the establishment of the above-mentioned canals, the globules will *advance further into the fibrin*, and approach nearer to the surface of the wound, *without being deprived of their colouring matter*. When this period has arrived, the fibrin, which was at first opaque, and of a dirty white colour, has assumed a jelly-like, and more transparent appearance, (in consequence of its combination with the serum, which is constantly passing through it,) actually contains real blood, and has every character which pertains to granulations." (See *W. Earle, in Lond. Med. Gaz.* 1835, p. 219.) This gentleman afterwards notices, that, although the establishment of the above-mentioned canals, or perforations, admits the red globules nearer to the surface, the continual deposition of fresh fibrin, which coagulates as it exudes, constantly maintains their orifices, as it were, sealed up, so that a new obstruction is uniformly opposed to the *final egress* of the globules. Through this fresh deposition, the globules are again forced as before, by the pressure of the *vis a tergo*; more fibrin is again deposited, and coagulated, and so on until the wound is filled up. Whoever is desirous of going further into this minute investigation, should consult Mr. J. W. Earle's paper above referred to, and also Gendrin's Hist. Anat. des Inflammations, in which latter is a careful description of the formation of granulations on a serous membrane. A lecture by Sir Everard Home, on the conversion of pus into granulations, likewise, merits attention. (See *Phil. Trans.* part 1. 1829.)

The vessels in granulations pass from the original parts to their basis, and thence towards their external surface, in tolerably regular parallel lines. The surface of this new substance has the same disposition to secrete pus, as the parts which produced it. The surfaces of granulations are very convex, the reverse of ulceration, and they present a great many small points, or eminences, so as to appear rough. The smaller such points are, the more healthy the granulations. The colour of healthy granulations is a deep florid red. When livid, they are unhealthy, and have only a languid circulation. Healthy granulations, on an exposed or flat surface, rise nearly even with the surface of the surrounding skin, and often a little higher; but when they exceed this, and take on a growing disposition, they are unhealthy, become soft, spongy, and have no disposition to form skin. Healthy granulations are always prone to unite to each other, so as to be the means of uniting parts.

Granulations are not easily formed on the side of an abscess, nearest the surface of the body.

They are not endowed with the same powers as originally formed parts. Hence, they more readily ulcerate, and mortify. The curious mode in which granulations contract, when sores are healing, and even for some time after they are healed, has been explained in the article *Cicatrization*. (See *Hunter on the Blood, Inflammation, &c.* p. 473. *et seq.* 1794.)

It is a question, whether grannlations can ever be formed without suppuration? Mr. Hunter seems inclined to think that they may occasionally be produced without it, and he supports his opinion by the relation of the dissection of a limb which had suffered a compound fracture, and in which he observed a substance resembling granulations. Dr. John Thompson, on the other hand, declares, that he has never seen any thing, which he could regard as an example of a granulation, and still less of a granulating surface, where pus was not formed. (See *Lectures on Inflammation*, p. 408.)

The exact process, by which the blood-vessels, nerves, and absorbents of granulations are formed, is still amongst the secrets of nature. The observations of Mr. Hunter on the subject amount only to conjecture. "The growth of nerves, and their developement in new-formed flesh, or granulations (says Dr. J. Thompson), is a subject of equal curiosity with the growth of blood-vessels in the same structure. Their existence in granulations is proved by the pain which is felt on our pinching, rubbing, or wiping the surface of a sore. Even the granulations, which arise from the surface of bone, are sensible (a statement not admitted by Sir Astley Cooper), though we are not very well able to prove the sensibility of the larger branches of nerves, from which the newly formed, and sensible nerves and filaments in the granulation are immediately derived. All the difficulties, which I formerly mentioned to you, as occurring in the explanation of the manner in which coagulable lymph, or granulations, are penetrated with blood-vessels, present themselves the moment we begin to reflect on the manner in which the same granulations are provided with nerves; and these difficulties are still increased, when we reflect, that the same granulations are in the course of a few hours provided, not only with bloodvessels and nerves, but also with a system of absorbents. The existence of absorbents in granulations is proved, not only by the changes of bulk, which we see them daily undergo, becoming gradually, in the healthy state smaller, firmer, and more compact, but, also, by the frequent disappearance, in whole, or in part, of a granulating surface, by the process of ulcerative absorption." (See *Thompson's Lectures on Inflammation* p. 419.) According to Sir Astley Cooper, granulations which spring from parts endued with great sensibility, like muscles, are extremely sensitive; but, granulations, which arise from bones, he says, have no sensibility whatever. These observations are qualified with the condition, that the bone be uninflamed, and, it is acknowledged, that granulations, arising from the cancellated structure of bones, are sometimes extremely sensitive. He describes granulations from tendons as quite insensible, and those from aponeuroses and fasciæ as possessing very little sensibility. Every young dresser of sores at an hospital, who has been too lavish of the red precipitate ointment, must have learned from experience, that granulations are furnished with absorbent vessels, and that mercury may be absorbed from the surface of ulcers, and bring on an unwished-for salivation of the patient. It is observed by Sir Astley Cooper, that, in recently formed ulcers, the granulations are not good absorbent surfaces; but, that when the sores have existed a good while, they readily take into the system any substance, which may be applied to them. Thus, when old sinuses are injected with a solution of the oxymuriate of mercury, with the view of stimulating them to heal, the patients are sometimes salivated by the mercury being absorbed into the system. Sir Astley has seen the same effect produced by the application of the lotion of lime-water and submuriate of mercury to the surface of ulcers. Indeed, the absorbent power of granulations is frequently the means of producing baneful effects upon the constitution, by the introduction of deleterious substances into the circulation. Thus, arsenic, applied to sores, is often conveyed into the system, and, on this account, is to be regarded as a dangerous external remedy. Sir Astley Cooper quotes one instance, in which the patient seems to have been poisoned, by the indiscriminate application of arsenic to a fungus of the eye. Opium also, when applied to the surfaces of sores, is very readily absorbed, producing similar effects to those which arise from its introduction into the stomach. Thus, when the quantity absorbed is too great, excessive costiveness, extreme pain in the head, and torpor of the system, are the consequences, which require the frequent administration of active purgatives for their removal. A temporary amaurosis has been known to be produced by the absorption of the extract of belladonna, from the surface of irritable malignant ulcers. (*F. Tyrrell; A. Cooper's Lectures*, vol. i. p. 169.)

GUAIACUM. Many writers of the sixteenth century contended, that guaiacum was a true specific for the venereal disease; and the celebrated Boerhaave, in the eighteenth, maintained the same opinion. Mr. Pearson mentions, that when he was first intrusted with the care of the Lock Hospital, in 1781, Mr. Bromfield and Mr. Williams were in the habit of reposing great confidence in the efficacy of a decoction of guaiacum wood. This was administered to such patients as had already employed the usual quantity of mercury; but who complained of nocturnal pains, or had gummata, nodes, ozæna, and such other effects of the venereal virus, connected with secondary symptoms, as did not yield to a course of mercurial frictions. The diet consisted of raisins, and hard biscuit; from two to four pints of the decoction were taken every day; the hot bath was used twice a week; and a dose of antimonial wine and laudanum, or Dover's powder, was commonly taken every evening. Constant confinement to bed was not deemed necessary; neither was exposure to the vapour of burning spirit, with a view of exciting perspiration, often practised; as only a moist state of the skin was desired. This treatment was, sometimes, of singular advantage to those whose health had sustained injury from the disease, long confinement, and mercury. The strength increased; bad ulcers healed; exfoliations were completed; and these anomalous symptoms, which would have been exasperated by mercury, soon yielded to guaiacum.

Besides such cases, in which the good effects of guaiacum caused it to be erroneously regarded as a specific for the lues venerea, the medicine was also formerly given, by some, on the first attack of the venereal disease. The disorder being thus benefited, a radical cure was considered to be accomplished; and, though frequent relapses followed, yet, as these partly yielded to the same remedy, its reputation was still kept up. Many diseases also, which got well, were probably not really venereal cases. Mr. Pearson seems to allow, that, in syphilitic affections, it may, indeed, operate like a true antidote, suspending, for a time, the progress of certain venereal symptoms, and removing other appearances altogether; but, he observes, that experience has evinced, that the unsubdued virus yet remains active in the constitution.

Mr. Pearson found guaiacum of little use in pains of the bones, except when it proved sudorific; but that it was then inferior to antimony, or ammonia. When the constitution has been impaired by mercury, and long confinement, a thickened state of the ligaments, or periosteum, or foul ulcers, still remaining, Mr. Pearson says, these effects will often subside, during the exhibition of the decoction. He says, it will often suspend, for a short time, the progress of certain secondary symptoms of the lues venerea; for instance, ulcers of the tonsils, venereal eruptions, and even nodes. Mr. Pearson, however, never knew one instance, in which guaiacum eradicated the virus; and he contends, that its being conjoined with mercury neither increases the virtue of this mineral, lessens its bad effects, nor diminishes the necessity of giving a certain quantity of it. He has seen guaiacum produce good effects in cutaneous diseases, ozæna, and scrofulous affections of the membranes and ligaments. (See *Pearson on the Effects of various Articles in the Cure of Lues Venerea*, edit. 2. 1807.) Many of the foregoing observations on the virtues of guaiacum in syphilis, are considerably affected by the fact, now so completely established, that this disease is generally capable, in the end, of a spontaneous and lasting cure. (See *Venereal Disease*.)

GUMMA, a soft tumour, so named from the resemblance of its contents to gum.

GUMS, INFLAMMATION AND ABSCESS OF. *Gumboil. Parulis.* Inflammation of the gums mostly arises from the irritation of carious teeth, but sometimes from necrosis of a part of the alveolary process, or from the splintering of it, occasioned by the extraction of a bad tooth. Sometimes it originates from exposure to cold, and, in other instances, from mechanical irritation. When the inflammation, arising from the irritation of a decayed tooth, cold, and some other causes, proceeds to suppuration, the case is then an abscess, here termed a *gumboil.* The treatment consists in making an early puncture, for the discharge of the matter, and, after the subsidence of the inflammation, in extracting any bad tooth, concerned in keeping up irritation. The mouth is to be frequently cleansed with an astringent gargle. If a fistula form in the gums, it is to be freely divided, and touched with the nitrate of silver, care being taken, however, before resorting to this measure, to remove any carious tooth, splinter, or dead portion of bone, which latter proceedings will, generally, supersede all necessity for laying open the fistula.

GUMS, TUMOURS OF. A very common disease is a thickening of the gums at some particular point, which puts on the form of an excrescence, and generally assumes a hard callous nature. Some of these swellings are connected with the periosteum, or bone, and are disposed to acquire a malignant character; frequently, after they have attained a certain size, the neighbouring part of the bone becomes altered and softened. Other tumours of the gums are merely excrescences from the fibro-vascular texture of these parts, not penetrating deeply, not connected with the bone, periosteum, nor sockets of the teeth, and not malignant. The excrescence of the gums then, termed *epulis*, is of very different character in different cases; but, as many tumours of the gums, apparently trivial at first, become fatal diseases in the end, if neglected in their beginning, the rule in surgery is to attempt their extirpation, before they have made considerable progress.

On this subject Sir Charles Bell has made some interesting remarks. "We see (says he) a small tumour of the gums, stationary for a long time, and claiming no attention, at last forcing its way into the bones of the face, filling up the cells and the cavities of the nose, pressing out the eyes, and rising at last upon the base of the brain itself," so as to destroy the patient. The worst diseases of the gums, according to Sir C. Bell, do not come from the irritation of a bad tooth. "We see a carious tooth, attended with ulcer and gumboil, and abscess in the jaw; with fungous tumour of the gums; even with necrosis of the jaw. We find the inflammation from the same source, amounting in severity of pain to that of tic-doleureux. But these are of no account, compared in danger with this tumour of which I am treating. This more formidable disease begins when the adjoining teeth are apparently sound, and when we cannot trace it to any common source of irritation. This tumour first shows itself in a small hard prominence of the gum, shooting out betwixt two of the teeth; and the teeth being good is an unfavourable circumstance; for, when they have become loose and are displaced, without being themselves diseased, it implies that the cause is deep, and not to be removed by pulling out the teeth. If the teeth be carious and originally in fault, we have a reasonable expectation of arresting the progress of disease by removing the teeth; but when, independent of the teeth, the tumour has its origin in the membrane of the fang, or in the socket, we cannot hope to extirpate the disease, without removing the whole system of parts," the tooth, the gum, and the adjacent portion of the jaw. (See *Sir Charles Bell's Surgical Obs.* p. 413. 8vo. Lond. 1816.) A perpendicular division of the alveolary process is to be made at a prudent distance from each side of the tumour, and to the requisite depth, with a fine saw, any teeth in the way of its action being previously extracted. Then with a strong pair of forceps, the portion of bone, between the two fissures, is to be broken off. The bleeding, which is copious, may somtimes be stopped by compresses dipped in the tincture of muriated iron, but frequently requires firm and long continued pressure with the hands of a succession of assistants, or even the actual cautery.

The soft and more superficial kinds of epulis may be extirpated with a scalpel, care being taken to let the excision be sufficiently free and deep, and then to scrape the alveolary process, or rub the bottom of the wound with nitrate of silver, which will generally stop the hæmorrhage, and lessen the chance of a return of the excrescence. When the disease recurs often, as it did six times in a case, mentioned by John Hunter, the removal of the parts must either have been imperfect, or the tumour cancerous, as happened in two examples which fell under his observation. (See *J. Hunter on Natural Hist. &c. of the Human Teeth*, p. 188.

GUNSHOT WOUNDS receive their name from the manner in which they are produced, being generally caused by hard, obtuse, metallic bodies, projected from cannons, muskets, or some other species of firearm. With such injuries, it is also usual to comprehend a variety of dreadful accidents arising from the explosion of shells, or the violence with which pieces of stones from ramparts, or splinters of wood on board of ship, are driven about. Gunshot wounds are the most considerable of the contused kind; and what is to be said of them, will apply, more or less, to all contused wounds, according to the degree of contusion. They are particularly characterised by, what the French surgeons are fond of calling, a *disorganization* of their surface. The excessive contusion and violence, observable in gunshot wounds, depend upon the rapidity with which the bodies occasioning them are propelled. The parts touched by the ball, are frequently converted into a blackish slough, the colour of which made our ancestors suppose, that bodies, projected by gunpowder, became heated, and actually burnt the flesh with which they came into contact. But reason and experience have now proved, that whatever may be the rapidity of a projectile, it never acquires in its passage any perceptible heat. Indeed, a modern writer asserts, that such a degree of heat as would be requisite to make a ball burn parts in its passage would really melt it. (*Richerand, Nosographie Chir.* t. i. p. 217. edit. 2.) In general, gunshot wounds do not bleed much, except when large blood-vessels are injured, and even not always in this case.

However, "the effects of a gunshot wound differ so materially in different men, and the appearances are so various, according to the nature of the part wounded, and the greater or lesser force with which it has been struck, that no invariable train of symptoms can be laid down as its *necessary* concomitants. If a musket or pistol-ball has struck a fleshy part, without injuring any material blood-vessel, we see a hole about the size of, or smaller than, the bullet itself, with a more or less discoloured lip, forced inwards; and, if it has passed through the parts, we find an everted edge, and a more ragged and larger orifice at the point of its exit. The hemorrhage is in this case very slight, and the pain may be inconsiderable, insomuch that, in many instances, the wounded man is not aware of his having received any injury. If, however, the ball has torn a large vessel, or nerve, the hemorrhage will generally be profuse, or the pain of the wound severe, and the power of the part lost. Some men will have a limb carried off, or shattered to pieces by a cannon-ball, without exhibiting the slightest symptoms of mental or corporeal agitation; nay, even without being conscious of the occurrence: and when they are, they will coolly argue on the probable result of the injury; while a deadly paleness, instant vomiting, profuse perspiration, and universal tremor, will seize another on the receipt of a slight flesh wound. This tremor, which has been so much talked of, and which to an inexperienced eye is really terrifying, is soon relieved by a mouthful of wine, or spirits, or by an opiate; but, above all, by the tenderness and sympathising manner of the surgeon, and his assurance of the patient's safety." (See *Hennen's Principles of Mil. Surgery*, p. 33. edit. 2.)

On the other hand, it is correctly noticed by Mr. Guthrie, that the continuance of the constitutional alarm, or shock, ought to excite great suspicion of serious injury; and when wounds have been received in such situations, or bear such appearances, as render it doubtful whether any parts of vital importance have been injured, or not, the manner in which the constitutional perturbation lasts may be assumed as evidence of the fact, when other symptoms more indicative of the injury are wanting; and, under all such circumstances, a very cautious prognosis should be delivered. (*On Gunshot Wounds*, p. 11, ed. 2.)

Respecting the general character of gunshot wounds not to bleed copiously, unless large vessels be injured, it is a fact which necessarily depends upon the degree of contusion usually attending these injuries. But it is also true, as the preceding author has stated, that, although some gunshot wounds bleed but little at first, there is in the greater number of cases more or less of blood; and in wounds of vascular parts, like the face and neck, the quantity lost is often considerable, though the main arterial branches may not be injured. (*Op. cit.* p. 6, ed. 2.)

In gunshot wounds another circumstance is observed, which is often remarked in other cases, viz., when a large artery is partially divided, the bleeding is more profuse and dangerous than when the vessel is completely severed, and the hemorrhage, if not repressed by a tourniquet or other means, will often continue until the patient dies. Thus Mr. Guthrie speaks of three cases, in which life was lost from wounds of the femoral, brachial, and carotid arteries, no effectual means of stopping the hemorrhage having been adopted. In 1830, a young man, at the attack on the Hôtel de Ville, in Paris, received a ball in the upper and inner part of the right thigh, and the femoral artery was wounded; he was conveyed to the Hôtel-Dieu, but lost so much blood in the streets, that, when he reached the hospital, he was in a dying state. (*Dupuytren, Clin. Chir.* t. ii. p. 464.)

Until Ambrose Paré introduced more correct theories, the most false notions prevailed respecting, what have been wrongly named, *wind-contusions*. Cannon-balls and bullets sometimes produce dreadful degrees of injury, without occasioning any breach of continuity in the integuments. This observation is so strictly true, that the muscles and bones may actually be crushed and broken to atoms, without the skin being at all wounded. Such cases were for a long while imputed to the violent motion supposed to be communicated to the air by the ball itself. It was imagined, that this elastic fluid, being rapidly displaced by the shock of the projectile, was capable of making such pressure on surrounding bodies, as to destroy their texture. But how could this violent pressure originate in the midst of the open and unbounded atmosphere? If this theory were true, the effect in question would constantly happen, whenever a ball passed near any part of the body. The contrary, however, is so much the case, that pieces of soldiers' and seamen's hats, of their feathers, clothes, and even hair, are shot away in every battle, without any other mischief being done.

The air does not move with the same rapidity as the ball; but its motion is less in proportion as it is a more subtile matter, and must be too feeble to account for such a violent degree of injury. The air, to which the ball must really communicate the greatest motion, is what is directly before it; and this never bruises the part untouched by the ball itself. It is only the air situated laterally to the shot, that is imagined to do injury, and it cannot be greatly agitated. The violent consequences of sudden explosions, and the effects produced on the organ of hearing, by strong commotions of the air, prove nothing relative to the point in question. (See *Le Vacher, in Mém. de l'Acad. de Chir.* t. iv. p. 22.)

Dr. John Thomson, who visited the continent for the purpose of seeing the wounded after the battle of Waterloo, fully coincides with M. le Vacher and all the moderns upon this subject. "We saw, and were informed of, many instances, in which cannon-balls had passed quite close to all the parts of the body, and had removed portions of the clothes and accoutrements, without producing the slightest injury of any kind. In other instances, portions of the body itself were removed by cannon-balls, without the contiguous parts having been much injured. In one case, the point of the nose was carried off by a cannon-ball, without respiration being at all affected; and in another very remarkable case, the external part of the ear was shot away, without even the power of hearing being sensibly impaired." (See *Thomson's Report of Obs. made in the British Military Hospitals in Belgium, &c.* p. 33. Edin. 1816.)

In proof of the truth of Le Vacher's opinions, I shall merely add one observation that occurred to the notice of many, as well as myself. At the bombardment of the French fleet in the basin of Antwerp in 1814, a cannon-shot shattered the legs of two officers so badly, that the limbs were amputated. These gentlemen were walking at the moment of the accident in the village of Merksam, taking hold of the arm of my friend Assistant-surgeon Stobo, of the 37th regiment, who was in the middle. Now the ball which produced the injury, did not the slightest harm to the latter gentleman, although it must have passed as close as possible to his lower extremities, and most probably between them.

Neither can what have been improperly called *wind-contusions*, be attributed to an electrical shock on the parts, in consequence of the ball being rendered electrical by friction in the calibre of the gun, and giving off the electricity as it passes by; (Vide *Plenck's Sammlungen*, 1 theil. p. 99.) for metals never acquire this property from friction.

The mischief, imputed to the air, is occasioned by the ball itself. Its producing a violent contusion, without tearing the skin, and entering the limb, is to be ascribed to the oblique direction, in which it strikes the part, or, in other instances, to the feebleness with which the ball strikes the surface of the body, in consequence of its having lost the greater part of its momentum, and acting principally by its weight, being, in short, what is called a spent ball. Daily observation evinces, that balls which strike a surface obliquely, do not penetrate, but are reflected; though they may be impelled with the greatest force, and the body struck may be as soft and yielding as water. This alteration in the course of the ball, not only happens on the surface of the human body, but also in the substance of a limb which it has entered. Thus, a bone, a tendon, &c. may change the direction of a ball which touches them at all obliquely. Hence, the track of a gunshot wound is not always straight, and balls sometimes run under the integuments nearly all round the body, or limb.

The causes of several of the peculiarities, attending gunshot wounds, are to be sought among the laws, by which moving bodies are governed, and by which the mechanical effect of a ball, propelled against any part of the body, must therefore be determined. The form, the momentum, and the direction of the shot, that is received; the position, and the variety of structure, or, in other words, the variety of density and powers of resistance, in the part receiving it, must always be considered, in order to account satisfactorily for the effects which it produces. And though, says Mr. Chevalier, in many cases, a mathematical explication of the course of a ball cannot be given, this arises entirely from the want of data, the laws of matter being fixed and immutable. But, when the data are known, as, for instance, the velocity and direction of the shot, the position of the patient, or of the wounded part at the time of the accident, and the structure of the parts penetrated, a much more probable conjecture of the course of the ball may generally be formed, than if these circumstances had not been regarded.

On the principle of the density and resistance of parts, attempts have been made to explain the reason of the concussion, or shock, which is given, in many instances, to the whole system by gunshot wounds, and which is sometimes represented to be often attended with grave and even alarming effects, extending not only over the injured part, but affecting the system at large. Thus a shot, striking against a tendon, or a bone, in one of the extremities, will produce a greater concussion, than if it struck only against softer parts. A shot, striking a muscle in action, will produce more concussion, than if it struck against the same part of the same muscle at rest; and a shot, striking the head, or wounding the liver, lungs, or intestinal canal, will generally bring on instantaneous derangement of the whole system. (*T. Chevalier on Gunshot Wounds*, part i. sect. 7.)

Respecting the mechanical effects of the concussion, I am disposed to think with Mr. Guthrie, that they have been exaggerated, and that in reality a more accurate explanation of the disorder of the system might be derived from other considerations. "A shot through the lungs (says he) will cause an instantaneous derangement of the whole system; but the resistance afforded by the part has little to do with it: it is the lesion of the organic functions, intimately connected with life, that is the cause of the derangement. In the same manner, I do not conceive, that the general affection of the system depends alone on the shock received, but on the effect the injury committed has on the nervous system." (*On Gunshot Wounds*, p. 26. ed. 2).

The swiftness of a musket-ball gradually diminishes, from the instant when it quits the gun until the time of its falling upon the ground. The air first makes a certain resistance to it, which causes it to deviate from a straight line, and occasions a diminution of its velocity. Every thing against which it strikes, deprives it of a part of its rapidity. In order to understand various peculiarities of gunshot wounds, it should also be recollected, that the ball has a double motion; one of projection, which describes a parabolical curve; the other of rotation on its axis, which sometimes continues after the first has ceased. (See *Dupuytren, Clin. Chir.* t. ii. p. 437.)

A ball, when it strikes a part of the body, may cause several kinds of injury. 1. It may only occasion a contusion, without penetrating the part, on account of its being too much spent, or of the oblique way in which it strikes the surface. 2. It may enter and lodge in the substance of a part; in which case, the wound has only one aperture. 3. It may pierce through and through; and then there are two openings, one at the entrance, the other at the exit of the ball. The circumference of the aperture, where the shot entered, is usually depressed or forced inwards; that of the opening from which it came out, elevated, or prominent. At the entrance there is commonly more contusion, and ecchymosis, than at the exit of the ball. The former opening is generally narrower; the latter wider, and more irregular, especially when the round smooth figure of the ball has been changed by its having struck a bone. The aperture, made by the ball, in the clothes, is always much narrower, than that occasioned in the corresponding integuments. 4. A cannon-ball may tear off a whole limb.

Gunshot wounds differ also according to the kind of body projected, its velocity, and the nature and peculiarities of the parts injured. The projected bodies are mostly bullets, sometimes cannon-balls, sometimes pieces of broken shells, and often, on board of ship, splinters of wood.

As is observed by a most eminent practitioner, the effects of gunshot wounds depend very much upon the manner in which the gun has been loaded, and the distance at which it has been discharged. If a fowling-piece is merely loaded with powder without any wad, and fired off very near the person who receives injury, the integuments are violently contused. But, if the same charge be rammed down, the effects will differ according to the degree of resistance, and the distance of the wounded party. The following case occurred in the practice of Dupuytren. Two persons quarrelled; and one of them discharged a fowling-piece, loaded only with powder, at the abdomen of his adversary, who instantly fell dead. The mouth of the gun had been not more than a foot or two from him. Dupuytren having been juridically required to ascertain the cause of death, found the clothes torn, a hole in the parietes of the abdomen more than an inch in diameter, the intestine wounded, and the wad in the middle of the abdomen. Parties attempting suicide sometimes, in their confusion, forget to put the ball into the pistol. The explosion occasions a violent distention of the parietes of the mouth; and though the vertebral column is not injured, the soft palate is lacerated, and sometimes the lower jaw fractured. (*Dupuytren*, in *Clin. Chir.* t. ii. p. 419.)

The many accidents which occur in the shooting season, should lead every surgeon to remember that small shot acts in two ways: it either strikes in a mass, "*il fait balle,*" as the French term it, which depends upon the goodness of the fowling-piece and its nearness to the wounded person, or else it is scattered and each shot hits separately. In the first case, its effects are generally more formidable, than those of a single bullet. (See *Dupuytren*, ib.) I lately visited, with Mr. Broxholm, of Sunbury, a young man who, in taking a fowling-piece out of a cart, received its contents at the inner and upper part of the arm, the mouth of the gun being at the moment close to the limb. The shots, in a mass, passed obliquely through it on the outer side of the humerus, occasioning an opening at their entrance not more than an inch and a half in diameter, but one at their exit much larger, and of an irregular triangular shape. This case was not followed by any very severe consequences, a circumstance to be ascribed partly to the patient's good constitution, and partly to the fortunate circumstances of the bone, as well as other important parts, having escaped injury, and no foreign body having lodged in the part. The wound was, however, attended with more laceration, than one caused by a single bullet would have been.

Angular, uneven bodies, such as pieces of iron, hammered leaden bullets, cut lead, fragments of bombshells, &c., produce far more dangerous wounds, than round smooth balls. Several persons were wounded at Paris, in the late disturbances, by irregular pieces of balls, which had been broken by striking first against iron bars. (*Clin. Chir.* t. ii. p. 429.) When a leaden ball has been hammered to make it fit the gun, it is lengthened into an oblong irregular body (*un lingot*), which often penetrates in the transverse position, and causes horrible lacerations of every texture which it enters. In sieges, many severe injuries are produced by fragments of stones and brickwork being driven about with immense violence, on being struck by cannon-balls. Even the ground itself is frequently scattered with such force as to cause injuries of a serious nature. Several examples of such occurrences are noticed by M. Larrey, jun. (See *Hist. Chir. du Siége de la Citadelle d'Anvers*, p. 42. &c.) Irregular angular bodies keep up inflammation, until they are discharged, in the course of the suppuration, or they are extracted. But the textures sometimes become habituated to the presence of a ball, which is regular and smooth, and not of too large a size. A ball of this kind has been known to lodge for a considerable time in the brain, the heart, or lungs. Fibrine is first effused around it, and, becoming organized, assumes the character of villous membrane, from which pus exudes, but which is rendered gradually thinner, puts on a smooth appearance, and at length secretes only a little serosity. Sometimes, however, the serous cyst accidentally inflames, an abscess forms, and fistulæ ensue, which continue as long as the cause of the irritation. According to the researches of Dupuytren, wherever balls lodge for a time, and excite inflammation and suppuration, they are enveloped in a cyst, whose structure resembles that of a mucous membrane; and after a certain period, a communication is established between the cavity of the cyst and some point of the surface, or of the interior of the body. On the other hand, when a ball excites neither inflammation nor suppuration, the cyst presents an orginization exactly like that of a serous membrane, and contains between it and the ball a limpid serosity. (See *Dupuytren*, in *Clin. Chir.* t. ii. p. 432.) If, after extracting the ball from such a cyst, the wound be closed and healed by the first intention, a swelling is apt to form, composed of a collection of serous fluid in the cyst which is left. Hence, Dupuytren recommends either the removal of the cyst with the ball, or filling it with lint.

On account of the contusion, which the parts suffer, from the violent passage of the ball through them, a part of the textures surrounding the wound is most commonly deadened, and must afterwards be thrown off in the form of a slough. Hence, such wounds are generally prevented from healing by the first intention, and most of them necessarily suppurate. This does not take place equally in every gunshot wound, nor in every part of the same wound; and the difference commonly arises from the variety in the velocity of the body projected; for, where the ball has passed with little velocity, which is sometimes the case at its entrance, but, still more frequently, at the part last wounded, the injury may sometimes he healed by the first intention. (*J. Hunter*, p. 523.)

I believe that few surgeons of the present day suppose, that the whole track of every gunshot wound must unavoidably suppurate, and slough; but, if this idea prevail, it is plain, from the preceding statement, that the authority of Mr. Hunter cannot be adduced in its support. At the same time I suspect, that few army-surgeons will be inclined to question the correctness of Mr. Hunter's account of the general occurrence of a degree of sloughing, or of the deadened state of a part of the surface of a wound, particularly in the vicinity of the entrance of the ball, or the truth of his observations about the common necessity of the separation of such slough before the parts will heal; and whether the dead parts be thrown off in small fragments with the matter, or larger portions, the fact is still correct. Dupuytren seems, indeed, not to admit Hunter's exception, for he describes the whole surface of the track of the ball as converted into an eschar, several lines thick, which must be thrown off by an inflammatory process, and suppuration. Hence, says he, union by the first intention is impossible, and the attempt at it frequently dangerous. (See *Clin. Chir.* t. ii. p. 450.)

M. H. Larrey, in his account of the gunshot wounds, which occurred at the siege of the citadel of Antwerp, has recorded several cases, where the solutions of continuity were perfectly regular, and more or less like those made by a cutting instrument. Thus, one which was caused by the fragment of a shell, carried away a portion of the integuments of the chest, leaving a wound of a regular and elliptical shape, resembling that produced by an amputation of the breast. Its sides were brought together without sutures, and a cure was speedily accomplished. (See *Hist. Chir. du Siége de la Citadelle d'Anvers*, p. 138.)

Foreign bodies more frequently lodge in gunshot wounds than any others, and are commonly of three kinds. 1. Pieces of clothing, or other things, which the ball forced before it into the limb. 2. The ball itself. 3. Loose splinters of bone. It is only when the ball strikes the naked flesh, touches no bone, and goes quite through the part, that the wound can be free from extraneous matter. Foreign bodies are the cause of numerous unfavourable symptoms, by irritating sensible parts, and exciting pain, inflammation, spasms, hemorrhage, long suppuration, &c.; and the more uneven, pointed, and hard they are, the more likely they are to produce these evils. Hence, spiculæ of bone are generally the most to be dreaded.

The great obliquity and length of the fissures, produced in the cylindrical bones by musket-balls, are such as are not remarked in any ordinary fractures. When I was with the army in Holland, in the year 1814, I had in the hospital at Oudenbosch, several fatal compound fractures of the thigh, caused by gunshot violence. The fissures in some of these examples were found to extend two-thirds of the length of the bone. This fact is noticed by Mr. Guthrie: "The fractures extend far above and below the immediate part struck by the ball, and, as far as depends upon my information from the examination of limbs that were amputated, farther downwards than upwards; so that, from a fracture in the middle of the thigh, I have often seen fissures extend into the condyles, and cause ulceration of the cartilages of the knee-joint," &c. (*On Gunshot Wounds*, p. 190.)

It is commonly stated that, when a cannon-ball tears off a limb, it produces a violent concussion of the whole body, and a general derangement of all its functions. This, however, is by no means always true. I saw, some years ago, in London, a young sailor, whose arm had been completely torn off at the shoulder, by a cannon-ball from one of the forts at Guadaloupe, in March, 1808: he suffered no dreadful concussion of his body, nor were his senses at all impaired. This case was very remarkable, as the scapula was so shattered, that Mr. Cummings, of Antigua, was under the necessity of removing the whole of it. The patient recovered in two months. The axillary artery did not bleed.

One occasional consequence of gunshot wounds is inflammation and suppuration of some internal viscus, especially of the liver. Mr. Rose classes these occurrences amongst the effects of constitutional irritation arising from local injury, and considers them as striking illustrations of the irregular action in the vascular system, to which that irritation may give rise. He is also of opinion that an explanation of the subject may be deduced from the principles laid down by Mr. Travers. (See *Med. Chir. Trans.* vol. xiv. p. 263.; and *Travers's Inquiry concerning Constitutional Irritation*, 8vo. Lond. 1826.) Several cases of the above nature are related in the *Mém. de l'Acad. de Chir.*; and many patients in the Peninsula, who had undergone secondary amputations for gunshot injuries, were destroyed by affections of their lungs, liver, &c. (See *Guthrie on Gunshot Wounds*, p. 74. *et seq.*) The true cause is phlebitis.

From the circumstance of the inner surface of gunshot wounds being often more or less deadened, they are late in inflaming. This explanation of the fact, as delivered by John Hunter, is the best yet offered. The fact itself of traumatic inflammation being at first generally more indolent, than that of a common contused wound, was noticed by Paré; and it gives to gunshot wounds, in their first stage, as Dupuytren observes, a deceitful appearance of mildness (see *Clin. Chir.* t. ii. p. 452.); for afterwards, the inflammation, which is often more considerable at the entrance than the exit of the ball, becomes very intense. But, when a ball has fractured a bone, which fracture has occasioned great injury of the soft parts, independently of that caused immediately by the ball itself, the inflammation will come on as quickly as in cases of compound fracture; because the deadened part bears no proportion to the laceration or wound in general. (*J. Hunter*, p. 524.)

From the same circumstance of a part being often deadened, gunshot wounds frequently cannot be completely understood in the first instance; for, in many cases, it is at first impossible to know what parts are killed, whether bone, tendon, or soft part. Nor can this be ascertained till the slough separates, which often makes the wound much more complicated than was previously imagined. For, some viscus, or a part of some viscus, or a part of some large artery, or even a bone, may have been killed by the violence. If a piece of the intestine has been killed, the contents of the bowel will begin to come through the wound when the slough separates. If a portion of a large blood-vessel is killed, a profuse, and even fatal hemorrhage may come on, when the slough is detached, although no material quantity of blood may have been previously lost. (See *Hunter*, p. 525.) Thus, several days after the receipt of the wound, and when all danger from inflammation is over, a bleeding *per anum*, occasioned by the separation of a slough from some internal vessel, may destroy the patient, as happened in a very interesting case reported by Mr. Guthrie. (p. 13. ed. 2.) A soldier of the 2d battalion of the 44th regiment was shot in the ham at the assault of Bergen-op-zoom, in 1814. There was no hemorrhage for ten days; but, at the end of this period, the popliteal artery gave way, and I was obliged to take up the femoral artery, by which means the bleeding was effectually stopped, and the man recovered. This fact, and another related by Baron Boyer (*Annuaire Méd. Chir. de Paris*, p. 364. 4to. Paris, 1819.), prove, that a ligature on the femoral artery may sufficiently check the current of blood through the popliteal artery to put a stop to hæmorrhage from a wound in it; and though such practice in some other cases of wounded arteries is inefficient, on account of the facility with which the blood passes through the anastomoses into the part of those vessels below the ligature (see Arteries), its general success, in gunshot wounds of the ham, would be of infinite advantage, not only on account of the difficulties of taking up the popliteal artery itself (difficulties ably depicted by Scarpa), but because laying open the inflamed and diseased parts would frequently have a fatal termination. Dupuytren and Delpech, on the latter principle, have in several instances taken up the femoral artery for the stoppage of bleeding from the tibial arteries in compound fractures; and with complete success. In University College Hospital, I took up the popliteal artery for the suppression of repeated and profuse hemorrhage from the posterior tibial artery, which had been divided in a lad, who, as he was cleaning a window, slipped, and his leg passed through the glass, and the posterior soft parts were divided down to the bone. As the bleeding ceased, the wound was dressed, but, in consequence of returns of hemorrhage, the house surgeon made several unsuccessful attempts to secure the ends of the artery, and the wound had at length assumed a formidable appearance, with considerable swelling and tendency to gangrene. I therefore preferred tying the popliteal artery. The result was entirely successful, no recurrence of bleeding having been experienced. At the same time, I would have surgeons always recollect the important difference between an aneurismal and a wounded artery; for as, in the first case, there is no outlet for the blood, the transmission of this fluid into the part of the vessel below the ligature may keep up a pulsation in the tumour, and retard the cure of the disease, but is attended with no risk of hemorrhage; while the same free passage of the blood into the wounded portion of a large artery would give rise to dangerous bleeding; and hence, the general necessity of applying two ligatures, one immediately above, the other below, the aperture in such a vessel. A single ligature on the brachial artery fails, as I had an opportunity of seeing in Holland, in a case of gunshot wound, where either that vessel, or the commencement of the radial, or ulnar, gave way, on the loosening of the sloughs; and, as there was considerable swelling, œdema, and inflammation of the limb, threatening gangrene, the surgeon, under whose care the patient was, deemed it right to perform amputation.

I should be sorry, if these observations were to hold out any general encouragement of the wrong and dangerous practice of applying only one ligature above a wound in a large artery, or in any recent case of *false diffused* aneurism. The remarks, delivered above, were chiefly intended to refer to gunshot wounds of the ham, with injury of the popliteal artery, and hemorrhage first breaking out several days after the receipt of the wound, when all the parts behind the knee are enormously swelled, and in a state of inflammation and suppuration. Here the hope of avoiding any additional violence, or injury of the diseased parts behind the knee, may be a good reason for taking the chance of stopping the bleeding by a ligature applied to the femoral artery; a reason, however, which would not exist in the case of a recent wound of the popliteal artery with a knife. At the same time, I believe this means of checking the current of blood will not always suffice, and that occasionally either the dangerous expedient of cutting open the swelling in this diseased state of the ham, and of applying a ligature above and below the aperture in the popliteal artery, must unavoidably be encountered, or amputation performed. Why the first plan has answered in some cases, and not in others, may depend upon the size and condition of the wound, or opening in the artery, and, in examples of sloughing, upon the degree in which the tube of the vessel may have been closed by the adhesive inflammation. Some wrong conclusions may also have been made, respecting the trunk of the vessel being wounded or opened, while in fact only a branch of it was concerned.

When the ball moves with little velocity, the mischief is generally less; the bones are not so likely to be fractured; the parts are less deadened, &c. However, when the velocity is just great enough to splinter a bone, which is touched, the splintering is generally more extensive, than if the impetus of the ball had been much greater, in which case a piece is more likely to be taken out. When the ball moves slowly, it is more likely to be turned by any resistance it may encounter in its passage through parts; and hence the wound is more apt to take a winding course.

The track of a ball is generally more or less tortuous, in consequence of the irregular retraction of the different textures, change of the wounded person's attitude, and the deviations of the projectile itself.

When a ball enters a part with great velocity, but is almost spent, before it comes out again, in consequence of the resistance it has met with, there may be a good deal of sloughing about the entrance, and little or none about the exit, owing to the different degrees of celerity with which the ball traversed the parts. (See *Hunter on Inflammation, Gunshot Wounds, &c.*)

The effects of a ball upon a bone are different in different cases. Sometimes they only amount to a contusion of it; but this accident, though slight in appearance, is frequently followed by perilous consequences. The periosteum, if not destroyed, inflames and separates from the bone, and necrosis ensues, to a greater or lesser extent. If the bone be of a spongy texture, the inflammation may spread far in its internal vascular structure. In the skull, the two tables are almost always attacked by necrosis, and the dura mater inflames consecutively. If the force of the projectile be such as to overcome the resistance of the bones, these are broken with greater facility, in proportion as their hardness is more considerable, and their elasticity less. The flat bones, like those of the cranium and the scapula, are sometimes perforated as cleanly as if a portion of them had been taken out with a circular saw. In other instances, they are more extensively broken and comminuted. A ball may break a part of a long bone, like the tibia, without a fracture being produced, extending through all its circumference; but, more commonly, the middle compact portions of the long bones are reduced into numerous fragments of various shape and dimensions. If the projectile retains but very little impetus, or strikes a bone obliquely, this may be fractured, without being at all splintered. Of this, two instances are recorded by Dupuytren. (*Clin. Chir.* t. ii. p. 442.)

Gunshot wounds may have either one or two apertures, according as the ball has lodged, or passed quite through the part. In some cases, the openings are diametrically opposite each other; in others, they are not so, the direction of the ball having been changed by the resistance which it met with from a bone, cartilage, tendon, &c. Thus a ball has been known to enter just on the inside of the ankle, and come out near the knee; to enter the forehead, and come out at the temple, &c. (*Richerand, Nosographie Chir.* t. i. p. 219. edit. 2.) Dr. Hennen mentions an instance, in which a ball entered near the pomum Adami, and, after running completely round the neck, was found in the very orifice at which it had entered. "This circuitous route is a very frequent occurrence, particularly when balls strike the ribs, or abdominal muscles; for they are turned from the direct line by a very slight resistance indeed, although they will at times run along a continued surface, as the length of a bone, along a muscle, or a fascia, to a very extraordinary distance." Dr. Hennen refers to cases, in which the ball traversed almost the whole extent of the body and extremities. "In one instance, which occurred in a soldier, with his arm extended in the act of endeavouring to climb up a scaling-ladder, a ball, which entered about the centre of the humerus, passed along the limb, and over the posterior part of the thorax, coursed among the abdominal muscles, dipped deep through the glutæi, and presented on the forepart of the opposite thigh, about midway down. In another case, a ball, which struck the breast of a man standing erect in the ranks, lodged in the scrotum." (*Principles of Military Surgery*, p. 34. ed. 2.) Le Vacher saw a case, in which a ball entered the front of the thigh, and came out at the point diametrically opposite, without the femur being broken. Facts of this description are all capable of explanation, by reference to the laws of projectiles, already noticed.

Indeed, as Dupuytren observes, nothing is more diversified and extraordinary than the course of projectiles amidst the textures of the body. In 1830, a combatant, on the *Pont d'Arcole*, was struck by a ball, which entered at the internal angle of the left eye; and the wound, which took a direction backwards, and rather to the right, seemed as if it had gone quite through the head. However, the ball, after passing below the cranium, made its exit above the right shoulder. The man soon recovered, without any dangerous symptoms. Another man was wounded in the head, on the *Pont Nótre Dame*; the ball went through his hat, travelled along the right side of the nose, penetrated the upper lip, broke four of the upper teeth, fractured the lower jaw, came out behind the chin, entered again at the root of the neck behind the clavicle, and lodged in the cushion of the left shoulder. This patient died of inflammation of the chest. (See *Clin. Chir.* t. ii. p. 448.)

When there is only one opening, we may infer, that the wound contains a foreign body. An exception to this observation occurs, however, when a ball, instead of tearing the clothes, or linen, carries a portion of them, in the form of a pouch, into the wound, and, when such portion of the clothes is withdrawn, the ball falls out; and if this circumstance be not noticed, the presence of a single opening may lead to the idea, that the bullet is lodged in the part. An instance of this kind is cited by Paré, for the purpose of refuting the former notion, that the ball burnt the parts. A case, in which a piece of a shirt was carried in this manner four inches into the flesh, is mentioned by Mr. Guthrie (p. 20. ed. 2.).

In 1814, a French soldier, wounded under the walls of Paris, was brought to the Hôtel-Dieu. On examining the upper part of the leg, Dupuytren found some cloth forced into the tibia; and on pulling it out, which required considerable effort, a ball was extracted, completely enveloped in a piece of gaiter. Amongst the wounded brought into La Pitié, in July 1830, was one case, in which a ball had penetrated the abdomen, propelling before it a portion of the shirt, which was not torn, and served very usefully to facilitate the extraction of the projectile. (See *Dupuytren*, in *Clin. Chir.* t. ii. p. 426.) It is possible also for a ball to be stopped immediately it has entered the body, and then to be ejected by the elasticity of the parts, against which it strikes, as the cartilages of the ribs. (*Guthrie*, p. 19. ed. 2.)

When there are two apertures made by one shot, the ball, or at all events a portion of it, has escaped; but pieces of the clothes, &c. may still be lodged in the part. Care must be taken, however, not to confound with these cases others, in which the plurality of openings has been made by different balls. "It is no uncommon thing (observes Dr. J. Thomson), for a ball, in striking against the sharp edge of a bone, to be split into two pieces, each of which takes a different direction. Sometimes it happens, that one of the pieces remains in the place which it struck, while the other continues its course through the body. Of a ball, split by the edge of the patella, I have known one half pass through at the moment of the injury, and the other remain in the joint for months, without its presence there being suspected. In the same manner, I have known a ball divided by striking against the spine of the scapula, and one portion of it pass directly through the chest, from the point of impulse, while the other moved along the integuments, till it reached the elbow-joint. But, the most frequent examples of the division of bullets, which we had occasion to see, were those which were produced by balls striking against the spherical surface of the cranium. It sometimes happens, that one portion of the ball enters the cranium, while the other either remains without, or passes over its external surface. Not unfrequently, in injuries of the cranium, the balls are lodged between its two tables, in some instances much flattened, and altered in their shape, and, in other instances, without their form being changed." From these facts, it must be evident, that even when a gunshot wound has two orifices, the surgeon cannot be certain, that the bullet has not been divided, and that no portion is lodged, unless the entire ball itself happen to be found. (See *Thomson's Obs. in Military Hospitals in Belgium*, p. 37, &c.) This part of the subject is noticed by all the best practical writers, and especially by Barons Larrey and Dupuytren. When a ball strikes against hard substances, it is liable, says Dupuytren, to be changed in its shape, flattened, or broken into fragments, so as to produce injuries, not readily accounted for. Thus, in one case mentioned by him, the ball struck against the sharp edge of the right tibia, and was split into two pieces, each of which passed through the calf of that limb, and then lodged in the calf of the other. Thus, five openings were made by a single ball. (*Dupuytren, Clin. Chir.* t. ii. p. 428.) In July 1830, a Swiss soldier was brought into the Hotel-Dieu, wounded by a ball, which had fractured the right parietal bone, and been split into two pieces, one of which escaped through the scalp, whilst the other passed through the posterior lobe of the brain, and lodged upon the tentorium. About the same period, another individual was admitted into the same hospital, with the occiput fractured, by a ball which was split, but fixed with the margin of the bone in its cleft. (*Dupuytren, Clin. Chir.* t. ii. p. 444.) A single ball, though not split, may produce several openings. M. H. Larrey mentions a case, in which a ball passed through the hand, then the skin of the groin, and next the left buttock, so as to cause six openings. (See *Hist. Chir. du Siége d'Anvers*, p. 67.) Mr. Guthrie once spoke to me of another instance, in which six openings were left by a single ball, that passed through both thighs and the scrotum.

As the ends of the vessels are contused and torn, gunshot wounds have generally at first little propensity to bleed seriously, unless vessels of importance happen to be injured. In the beginning there may even be little hemorrhage; though a considerable artery be so hurt, that it afterwards sloughs, and a dangerous, or fatal, bleeding arises.

Thus (as I have already mentioned), in one of my own patients, who had received a musket-ball through the ham, the popliteal artery gave way about ten days after the injury, and compelled me to take up the femoral artery; and, in the Elizabeth Hospital at Brussels, amongst the patients under the care of my friend Mr. Collier and myself, about a week after the battle of Waterloo, the cases of hemorrhage, on the loosening of the sloughs, were numerous, not at all coinciding with a calculation, that the proportion of such examples, requiring the ligature of arteries, is only three or four in 1000. (*Guthrie on Gunshot Wounds*, p. 8. ed. 2.) In Holland, the truth of Mr. Hunter's observation upon this point appeared to me to be completely confirmed.

It has long been known, that a limb may be torn, or shot off, even near to the trunk of the body, and hardly any hemorrhage arise. We had numerous proofs of this fact after the battle of Waterloo. I had under my care a man of the rifle brigade, whose arm was shattered to pieces as high as the shoulder, yet there was no hemorrhage. I amputated the thigh of a Dutch soldier, whose leg had been completely shot off by a cannon-ball; but there was no hemorrhage before the operation. At Merksam, in 1814, I saw a case, in which the greater part of the clavicle, scapula, and many adjacent parts, had been carried away by a cannon-ball; and yet no bleeding of consequence occurred. The reason why a gunshot wound sometimes does not bleed much, though an artery of magnitude is torn, is because the vessel is nearly in the same state as when torsion has been practised; that is to say, the end of it has been violently stretched, so as to draw out the elastic external coat from the inner ones, which remain in the form of irregular folds, within the mouth of the artery, constituting a kind of barrier against the escape of the blood. But, if the artery be only partly torn through, this change is not sufficiently complete, and a profuse and fatal hemorrhage may immediately follow the wound. The eschar and clot that forms within the vessel, are also additional obstacles to the bleeding.

Sometimes, after a limb has been shot off, the large arteries do not bleed in amputation. "We saw a man (says Dr. Thomson), whose leg had been shot off by a cannon-ball; in amputating his limb above the knee, the arteries of the thigh were not perceived to bleed; nor did any of them afterwards require to be tied. A case, similar to this, also presented itself, in which the arm had been shot away close to the shoulder-joint."

Sometimes the contusion, produced by a cannon-ball, or the passage of a bullet in the vicinity of a large artery, seems to cause a laceration of the inner coat of the vessel, and a subsequent obliteration of its cavity by the effusion of coagulable lymph. Facts in proof of this statement are recorded by Dr. Thomson. (See *Obs. in the Military Hospitals in Belgium*, p. 34, 35.)

In general, the most dangerous kind of hemorrhage from gunshot wounds is that named *consecutive*, or *secondary*. Either the artery has been totally, or partially divided. In the first case, the slough immediately produced by the ball, the clot, which forms in the cavity of the vessel up to the first collateral branch, and (as I should add) the irregular folds of the inner coats, detached from the outer, put a stop to the bleeding. But, frequently, as soon as the circulation acquires strength, these impediments are overcome, and hemorrhage comes on. In other cases, they continue to be efficient, until the whole internal surface of the wound, and the lacerated and disorganised part of the artery, are detached and loosened, as suppuration advances. But, in this stage, if the end of the obliterated artery is too short, if the adhesive process is incomplete, or the patient moves about too much, the artery will give way. As Dupuytren observes, it is most commonly about the tenth, fifteenth, or even as late as the twentieth day, that these secondary hemorrhages happen, without any particular symptom to give warning of their occurrence, excepting a thin bloody serosity, which is sometimes discharged from the wound. Hence the necessity for the utmost vigilance at the period, when such bleedings are to be expected. They are infinitely more perilous than primary hemorrhages, both on account of the patient's weakened state, and the condition of the arteries and surrounding textures, occasioned by the inflammation. In cases of primary hemorrhage, the artery may be readily distinguished, taken hold of, and tied; and the ligature does not separate before the expiration of several days, when the process of obliteration has been insured. But, in secondary hemorrhages, circumstances are different. The tissues are retracted and converted into a compact mass, and the vessel, which can hardly be discerned, is easily cut through by the ligature, or, at all events, the latter falls off before the obliteration has acquired adequate strength. Hence, bleeding frequently comes on again in the course of a few hours. In cases of this description, Dupuytren observes, there is no other resource but that of taking up the trunk of the artery at a greater or lesser distance from the accidental opening in it. (See *Clin. Chir.* t. ii. p. 465.)

Still later forms of secondary hæmorrhage occur in gunshot wounds, complicated with hospital gangrene, or bad compound fractures, which have been in the suppurative stage for weeks, or months. In these last examples, even small arteries may pour out at once, or by repetition, a quantity of blood, sufficient to bring the debilitated patient quickly to the grave. The blood does not issue from one individual vessel, but from the whole surface of the wound, as from a sponge, and is so thin as to resemble blood and water.

Gunshot wounds, particularly those of the limbs, are frequently complicated with broken bones, which are a principal source of danger. The bones are seldom fractured merely in one place; but almost always splintered into numerous irregular pieces, which the violence of the shock often separates from the rest of the bone, and forces into the surrounding soft parts. If, to such mischief, be added that which the soft textures experience from the direct action of the projectile itself, the laceration of muscles, tendons, fasciæ, nerves, and blood-vessels, there will be exemplified, as Baron Dupuytren justly remarks, a combination of every thing bad, which a complicated fracture can be attended with. In no situation is the danger greater, than in the leg and thigh; in the former, on account of the thickness of the muscles and fasciæ; in the latter, on account of the number and size of the bones. The immediate consequence of the fracture, and the presence of splinters, is a violent inflammation, commencing in the broken part, and propagating itself to the whole limb. The textures, most seriously contused, are frequently seized with gangrene; and, after the sloughs have been detached, extensive portions of bone are left exposed. This is very often noticed in fractures of the leg. The suppuration becomes profuse; the fragments of bone lie inundated in pus, and, becoming denuded, lose their vitality; and the pus itself passes by long sinuses between the layers of muscles, and along the surface of the bone, to a vast distance. If a fragment of bone lie near an artery, its pressure will sometimes cause ulceration of the vessel, and a very late form of secondary hemorrhage. This danger is principally observed in the leg and thigh. M. Pelletan relates a case, in which the bleeding from this cause took place as late as the seventieth day. (See *Dupuytren, Clin. Chir.* t. ii. p. 455.)

This distinguished surgeon divided the spiculæ or fragments of comminuted gunshot fractures into *primary*, *secondary*, and *tertiary*. The primary are those which are completely detached by the violence, and must perish. They are, to all intents and purposes, foreign bodies, entangled in the flesh, or the bone. In the flesh, they give rise to profuse suppuration; in the bones, to less; and, if not removed, they occasion and keep up fistulæ. The *secondary splinters* are such as still retain a connection with the periosteum, or the bone. Some of them lose this connection, and then get into the state of *primary splinters;* while others retain their link, and continue to live. In this circumstance, they become almost always enveloped in the callus, and usefully contribute to its formation. The *tertiary splinters* are badly named, being, in fact, the result of necrosis, and corresponding altogether to what are termed *sequestra*. (See Necrosis.) These remain until detached by the same process, which loosens dead pieces of bone in general. So long as this process is not completed, the ends of the fracture cannot unite; and fistulous apertures continue. If these sequestra are too large to be expelled, they may become surrounded by new bone. In such cases, the limb is generally shortened and deformed; the callus bulky and irregular; and the sequestrum may be felt with a probe passed into one of the fistulous openings. Here the indication is to enlarge the opening, trephine, or remove some of the callus, and extract the dead piece or pieces of bone. (See *Dupuytren, Clin. Chir.* t. ii. p. 457.)

Treatment of Gunshot Wounds.

When the case is merely one of *contusion*, without wound, or disorganisation of textures, the surgeon may sometimes prevent inflammation, or keep it within due bounds. The cure may then be accomplished, without any solution of continuity in the skin taking place. But, more commonly, as Dupuytren observes, acute inflammation comes on; the parts are rapidly seized with gangrene; and, if the mischief be extensive, death is almost sure to follow. Textures, whose organisation has been too much injured by contusion, cannot bear inflammation. The mortification sometimes reaches further than first appearances enable us to foresee; and it is only now that the alarming nature of the case is manifest. As for *wounds*, whether they implicate only the soft parts, or the bones also, they are of a kind, which, in general, must unavoidably suppurate; but the prospect of cure will be greater, in proportion as their depth is less; as they are free from foreign bodies; and the general condition of the patient is satisfactory. (See *Dupuytren, Clin. Chir.* t. ii. p. 451.)

The first thing, in the treatment of a gunshot wound of a limb, is to determine, whether it be most advisable to amputate immediately, or to undertake the cure of the wound. When a bone, especially at a joint, is very much shattered; when the fleshy parts, particularly the great bloodvessels and nerves, are lacerated; when the whole limb has suffered a violent concussion, and is cold and senseless; there is no hope of preserving it. In this case, it is the surgeon's duty to amputate at once, and not to delay till inflammation, fever, and a tendency to mortification come on. But, besides this violent degree of injury, in which the propriety of amputation is obvious, several lower degrees occur, in which it is often a difficult thing to decide whether the operation be necessary or not. Here the surgeon must look not only to the injury, but also to the patient's constitution, and even to external circumstances, such as the possibility or impossibility of procuring good accommodation, rest, attendance, and pure air. But it is impossible to determine the necessity of amputation by general rules. In every individual case, the surgeon must consider maturely the particular circumstances, before he ventures to decide. The grounds against the operation are, the pain which it causes at a period when the whole system is disordered by a terrible injury; the privation of a limb; and frequent examples, in which nature, aided by judicious surgery, repairs the most horrible wounds. The following are the reasons in favour of the operation. By it the patient gets rid of a dreadful contused wound, which threatens the greatest peril, and which is exchanged, as it were, for a simple incised one. The pain of amputation is not of more moment than the pain which the requisite incisions, and the extraction of foreign bodies, would cause in case the operation were abandoned. In cases of gunshot wounds, the loss of the limb cannot be taken into the account; for the surgeon only undertakes the operation where he designs to save the patient's life by that privation, and anticipates that the part itself cannot be preserved. Even if he should deprive the patient of a limb, that, perhaps, might have been preserved, there is this atonement,— that he can furnish him with an artificial leg, which often proves far more serviceable than the limb would have proved, had it been preserved. Should the operation be fixed on, it is to be immediately performed above the wound. (*Richter, Anfangsgr. der Wundarzn.* b. i.)

When amputation is deemed unnecessary, the surgeon, according to precepts formerly in vogue, is to dilate the wound by one or more incisions. Many of the missile weapons employed by the ancients, when received into the body, required incisions before they could be extracted; and this was the case, not only with regard to darts and arrows, but also with regard to bits of stone, pieces of iron, and leaden bullets, which were thrown by means of slings. Celsus mentions the necessity of enlarging the orifices, through which these bodies had entered, and may therefore be justly regarded as the first, who recommended the practice of dilatation in the treatment of wounds made by leaden bullets. (*Thomson's Obs. in the Military Hospitals of Belgium*, p. 39.)

Such a dilatation has been said to have numerous advantages: to facilitate the extraction of foreign bodies; to occasion a topical bleeding, and afford an outlet for the extravasated fluid in the circumference of the wound; to convert the fistulous form of the track of the ball into an open wound; and, lastly, to remove the pressure and constriction of unyielding fibrous textures from the subjacent inflamed and swollen parts, and thus prevent gangrene. (See *Dupuytren, Clin. Chir.* t. ii. p. 452. and 475.) With the French surgeons, indeed, the practice of dilating the orifice of almost every gunshot wound seems to be the prevailing one, as may be seen by reference to the treatment of the cases which happened at the siege of the citadel of Antwerp. (*H. Larrey, Hist. Chir. du Siége, &c.* p. 68. &c.) I think, however, that the practice should be generally restricted to the circumstances specified by Dr. Hennen, which will be presently noticed.

Experience proves (*Hunter*, p. 529.) that the utility of such incisions has been overrated; that they generally increase the inflammation, which, in these cases, is so much to be apprehended; that wounds which are not dilated, commonly heal more speedily than others which are; and that there are only a few cases, in which incisions are beneficial. In fact, as Dr. Hennen has correctly stated, the knife is now rarely, if ever, employed in the first instance by English surgeons, except for the purpose of extracting balls, splinters of bone, and other extraneous bodies, or for facilitating the application of ligatures to bleeding vessels. (See *Principles of Military Surgery*, p. 49. ed. 2.)

If afterwards the parts inflame and suffer pressure, or constriction from a fascia, then, however, no surgeon would doubt about the necessity of a free division of the unyielding texture.

The injuries, arising from the practice of indiscriminate dilatation (says Dr. Thomson), were very early pointed out by Botallus; and it is singular, how much the opinions of this author, with regard to this point in military surgery, coincide with those of Mr. Hunter. (*Op. cit.* p. 40.)

The cases of gunshot wounds are various. Sometimes the track of the ball lies superficially under the skin, and only has one opening. When it lies in soft parts, and the ball has neither touched a bone, nor a considerable blood-vessel, all incisions are useless, let the wound have one or two apertures. Though dilating the wound has been practised with the view of giving vent to matter, eschars, and foreign bodies, and even its whole track has been laid open, when superficial; yet, the plan has not received general approbation. As, when a ball has passed with great force, there is often a real loss of substance in the skin, a portion of which is driven inward before the ball, it follows, that the opening of a gunshot wound must be more capacious than that of a punctured one. By the separation of sloughs, the wound becomes still more dilated, so that not only matter, but foreign bodies, which approach the skin, easily find an exit. Besides, incisions commonly soon close again, and, in a few days, the wound falls into the same state, as if no dilatation at all had been made. (*Hunter*, p. 532.)

Fasciæ, or other fibrous textures are often situated about the orifice of a gunshot wound, and some surgeons have made it a rule always to divide them completely, lest, when the wound inflames, the tension and confinement of parts should cause violent spasms and nervous symptoms, and afterwards impede the discharge of matter and foreign bodies. When they obviously have the first effects, the propriety of dividing them cannot be doubted: but with a mere expectation of the other evils, the real advantage of the practice is questionable. Here, Mr. Hunter remarks, the method would be very good, if tension and inflammation were not a consequence of wounds, or, if it could be proved, that the effects of dilating a part, that is already wounded, were different from those of the first wound; but, the employment of the knife, being only an extension of the first mischief, must be contradictory to common sense, and common observation. (*On Gunshot Wounds*, p. 534. 4to.)

Perhaps, however, Mr. Hunter carried his objections to the dilatation of gunshot wounds rather too far; for the effects of the dilatation, though certainly amounting to additional injury of textures, are different from those of the first wound, inasmuch as fibrous unyielding textures are freely divided, so that they can now neither dangerously compress and constrict the subjacent inflamed parts, nor confine the purulent matter which must soon form.

The extraction of foreign bodies ranks as one of the most urgent motives for the dilatation of the wound, and, no doubt, it is right to remove at first as many of them as possible. Their lodgment irritates the wound, causes violent nervous and inflammatory symptoms, and copious suppuration; circumstances, which the timely extraction of them may prevent. Yet, let it be remembered, that the extraction of foreign bodies is frequently attended with immense irritation, and that, while they lie too firmly fixed in parts, it is often a matter of impossibility. After the sloughs have separated, and the wound has become widened, suppuration frequently does not prevail long before the extraneous substances become loose, spontaneously approach the skin, and easily admit of removal, perhaps without any dilatation.

Hence, it is generally prudent to extract, at first, only such foreign bodies as are near the external opening, quite loose, and removeable without much irritation; or such as press on parts of importance, and thereby excite dangerous symptoms. The surgeon should avoid interfering with those which are deeply and firmly lodged in the wound. He should await suppuration, and the detachment of sloughs; and when the foreign bodies become moveable and apparent, he should extract them, with or without an incision, as circumstances may demand. The examination of the wound ought to be made as much as possible with the finger, which irritates less, and feels more distinctly than a probe. A great variety of instruments have been devised, either for ascertaining the position of balls, and other foreign bodies in gunshot wounds, or for extracting them. But, however numerous and diversified bullet-drawers may be, they all admit of being divided into three kinds. The first are constructed on the principle of a pair of forceps; others are shaped more or less like spoons; and a third description are made on the plan of a cork-screw or worm. These last are only designed for cases, in which the ball is fixed in the substance of a bone, and is quite immoveable; for, if it were lodged in the soft parts, the pressure, requisite for introducing the screw into it, would injure and lacerate the parts at the bottom of the wound. Bullet-drawers, constructed on the plan of forceps, have the inconvenience of not being adapted for seizing the ball, unless their blades can expand, which always stretches the wound, and creates a great deal of irritation. Forceps have been contrived with blades, which may be introduced separately, and then joined together with a screw. When a ball lies superficially, the fingers, or a small pair of forceps, will extract it most conveniently. And, with respect to bullet-extractors, as Dr. Hennen has justly observed, they are completely superseded by the common forceps, or that of Baron Percy, though unfortunately the aid of instruments is most required in tortuous deep passages, where we can least make use of them. (*Principles of Military Surgery*, p. 76. ed. 2.)

The event of the treatment above recommended, is various. Extraneous substances remaining in the wound, either loosen gradually, and come into view, so as to be easily removeable; or they continue concealed, prevent the cure, and give birth to a fistulous ulcer. In some instances the wound closes, and the foreign bodies remain in the limb during life, without inconvenience; and in other cases, after a time, they bring on a renewal of inflammation and suppuration. Sometimes a foreign body varies its situation, sinking down, and afterwards making its appearance at a different part, where it may excite inflammation and suppuration. It may change its place slowly, or quickly; when quickly, it leaves no trace of its passage in the textures, which it travels through; when slowly, it becomes enveloped in a serous cyst. This disposition to change of place appertains, not only to sharp, smooth, oblong bodies, but also to globular ones; though it is generally less, in proportion as they have more of the spherical shape. As Dupuytren observes, these facts should not be lost sight of by the surgeon; for it often happens, that a foreign body, which is distinctly felt on one day at a certain point, may be very far from it on the next. Hence, incisions for the extraction of a ball, are never to be made but from the present information acquired respecting its situation. (See *Dupuytren, Clin. Chir.* t. ii. p. 434.)

When the ball lodges in the wound, it is usually difficult to trace it, as the parts collapse after its passage, and leave an opening in the skin much smaller than the ball itself. The ball does not regularly take a straight direction through the injured part, but, often, a very tortuous one, particularly when the ball is nearly spent. In every case, in which it is not easily discoverable, all painful examinations should be abandoned, and the foreign body left in its situation, until its place is better known, and the first inflammation is over.

Sometimes the ball may be both easily found and extracted. At other times, it lodges on the opposite side of the limb, closely under the skin. According to Mr. Hunter, if the integuments, under which the ball is lodged, should be so contused that they will probably slough, they are to be considered as already dead, and an opening is to be made in them for the extraction of the ball. But, when the ball lies so remotely from the skin that it can only just be felt, and the skin itself is quite uninjured, no counter-opening ought to be made. The wound heals better when the ball is left in, and far less inflammation takes place in the vicinity of this extraneous body, than about the orifice of the wound. A counter-opening always renders the inflammation at the bottom of the wound, as great as at its orifice. It is better to let the wound heal up, and extract the ball afterwards. (See *Hunter*, p. 541.)

To the justness of this advice, Mr. Guthrie does not assent, who assures us, that he has cut out a great number of balls, which were not more than an inch from the surface, and never found any inconvenience ensue. But, when the ball lies three or four inches from the surface, and cannot be distinctly felt, he thinks, that no incision should at first be made with the view of extracting it. (*On Gunshot Wounds*, p. 94, 95. ed. 2.)

Sometimes, the ball penetrates the spongy part of a bone and lodges firmly in it. When it has only entered superficially, it may sometimes be loosened and extracted, by means of an elevator with a thin and somewhat curved extremity, and when it is more firmly fixed, a screw bullet-drawer will sometimes serve for its removal. Should the attempt fail, the employment of a trepan for the removal of the ball is recommended by some writers; while others, fearful of the irritation, difficulty, and effects of such an operation, and recollecting that balls have sometimes remained fixed in bones for many years, without any serious inconvenience, condemn that practice. On the contrary, Mr. Guthrie lays it down as a general rule, subject to a few exceptions, that a ball should never be allowed to remain in a bone; for, says he, "if a ball lodge in the head of a bone, and is not removed, it generally causes caries of the bone, disease of the joint, amputation, or death. If in the shaft of a long bone, necrosis for the most part follows, with months and years of misery. On a flat bone, caries is equally the result, and if it be surrounded by large muscles, sinuses form in various directions, contractions of the limb take place, and the patient drags on for years, careless of life, and ready to submit to any thing to obtain relief. (*On Gunshot Wounds*, p. 91. 93. ed. 2.) In many of these cases, one thing deserves to be recollected, however, that the necrosis, abscesses, and sinuses are less the effect of the lodgment of the ball, than of the violence originally committed on the parts, against which it has struck. Although Baron Larrey only sanctions the attempt to remove balls with a trephine, when they actually produce dangerous effects (*Mém. de Chir. Mil.* t. iv. p. 185.), I am disposed to believe, that whenever the situation of the ball is such, that it can be removed at once from a bone with tolerable certainty, and without too much irritation, the practice is commendable.

As soon as the requisite incisions have been made, and foreign bodies extracted, the prime objects in the treatment of gunshot wounds are accomplished, and the rest is, in reality, not different from the surgery of other wounds.

With regard to probing gunshot wounds, when it is evident that the shot has passed out, and no particular object can be fulfilled with the probe, it is often better to dispense with such examination, at least til' suppuration has come on. The needless use of a probe causes unnecessary pain and irritation. But when the ball, or any other extraneous substance, has lodged in the wound, and its situation is not immediately evident, it will often be advisable to search for it at once, in order that it may be extracted, if its situation will allow, before inflammation begins. The surgeon, therefore, considering all the circumstances which can assist him in forming a reasonable conjecture of the course of the wound, must give to a probe that curvature, or form, which he thinks most likely to pass readily along it, and must then proceed to make the examination. But, when this is very painful, and the course of the wound obscure, it will often be better to desist, and renew the search when suppuration has taken place, in which stage it can be undertaken with more ease, and a greater prospect of success. When gunshot wounds are inflamed, the tenderness and swelling of the parts are peculiarly strong reasons against painful probings, or efforts to extract foreign bodies, as long as this state lasts. (See *Chevalier on Gunshot Wounds*, p. 67, 68. edit. 3.)

There is no fact in the practice of surgery better established, than that the cramming of narrow stabs and gunshot wounds with lint is particularly hurtful. The only possible reason for doing so in the latter cases must be to keep the orifice of the wound from healing up, and confining extraneous bodies, matter, &c. The apprehension of this happening at first is quite unfounded; for the inside of the mouth of the injured part is often lined with a slough or eschar, which must necessarily be detached before the parts can heal. The first dressings, therefore, should be quite superficial, and of a mild unirritating nature. On the field of battle indeed, it would be well for many of the wounded, if the surgeon were to content himself with applying simple pledgets, and covering the part with linen dipped in cold water. What is termed the *water dressing*, consisting of lint wetted with cold or tepid water, and covered with a piece of oiled silk, is an excellent first application for gunshot wounds. These methods would prove much more beneficial, than the hasty and indiscriminate use of adhesive plasters, sutures, and tight bandages, from the bad effects of which thousands of soldiers have lost limbs, or lives, which, under more judicious treatment, might have been saved. Hunter used to employ fomentations, pledgets of simple ointments, and, frequently, over the latter an emollient poultice. In the suppurative stage of gunshot wounds, poultices are generally considered to be the best applications.

In considering the effects of poultices and cold applications upon gunshot wounds, Mr. Guthrie expresses his decided preference to the use of cold water:—"The inflammation is, in some instances, materially prevented, in many greatly controlled, and, in almost all, very much subdued by it, whilst the suppurative process is not impeded, in the generality of cases, in a degree sufficient to interrupt the subsequent one of granulation. In all simple cases of gunshot wounds, that is to say, flesh wounds, in persons of a healthy constitution, a piece of lint, which has been dipped in oil, or on which some ointment has been spread, is the best application at first to prevent irritation, with two slips of adhesive plaster placed across to retain it in its situation. A compress, or some folds of linen, wetted with cold water, are then to be applied over it, and kept constantly wet and cold, even by the use of ice, if it can be obtained, and be found comfortable to the feelings of the patient. A roller is of no use, except to prevent the compress from changing its position during sleep, and is, therefore, at that period useful; but, as a surgical application, it is useless, if not positively injurious, because it binds a part, which ought, to a certain extent, to swell, and by pressure causes irritation. Rollers ought not to be applied surgically until after some days have elapsed; and it is inexpedient to employ them in the field of battle, even if they were useful, except where some parts are to be kept in position; because, when they are applied in the first instance, they soon become stiff and bloody, are for the most part cut, and are seldom preserved after the first dressing, so as to become useful at the period when the surgical application of a roller is indispensable." To this just censure of the wrong employment of rollers, Mr. Guthrie annexes some remarks, in which he enters into a general condemnation of poultices, as applications to gunshot wounds, believing, that in many instances, cold water may be employed, with the best effect, during the whole progress of the cure. These remarks are tempered with the following admission.—"Cold water is not, however, an infallible, or even always an advantageous remedy: there are many persons, with whom cold applications do not agree; there are more, with whom they disagree after a certain period; and, in either case, they should not be persisted in. Cold does no good in any stage of inflammation, when the sensation accruing from the first application of it is not agreeable to the feelings of the patient; when, in fact, it does not give relief; for, if it produces a sensation of shivering, or an uncomfortable feeling of any kind, with stiffness of the part, it is doing harm, and a change to the genial sensation of warmth will not only prove more agreeable, but more advantageous. This occurs in general about the period when suppuration has taken place; and cold, in such cases, is preventing the full effect of the action which warmth encourages. Fomentations are then proper: and, if a poultice be preferred for convenience, by day or by night, an evaporating one of bread will be found sufficient. In the spring of the year, the marsh mallow makes an excellent poultice, and so do turnips, gourds, carrots, &c. independently of oatmeal, linseed meal, Indian meal, and other farinaceous substances. In all those cases, where a poultice is resorted to, as much attention is to be paid to the period of removing, as of applying it. It is used to alleviate pain, stiffness, swelling, the uneasiness arising from cold, and to encourage the commencing, or interrupted, action of the vessels towards the formation of matter; and, as soon as the effect intended has been gained, the poultice should be abandoned, and recourse again had to cold water, with compress and bandage." (p. 62—67. ed. 2.) Although I fully coincide with Mr. Guthrie, respecting the general advantage of cold water, the dangers of tight bandages, and the bad effects of continuing poultices too long, I do not join him in many of the sentiments which he has expressed about these last invaluable applications. On the contrary, I appreciate them as the best means, wherever a slough is to be thrown off, or matter is decidedly forming, and, as these effects are very frequent in cases of gunshot wounds, my own opinion of the utility of cold applications is limited to the first three or four days after the receipt of the injury. Nor ought cold applications ever to be continued, where the torpor, low temperature, and languid circulation in the limb, indicate a risk of gangrene. Hence, when a principal artery is tied, their employment is always wrong and hazardous. At the same time, I have no hesitation in declaring my firm belief, that fifty times more mischief has been done by tight rollers applied to recent gunshot wounds, than by either poultices or cold applications.

Gunshot wounds generally demand the employment of antiphlogistic means, just as other cases, attended with equal inflammation. When they are in the inflamed state, the application of leeches is highly proper. In these cases bleeding is recommended, and in such a manner as if it were of more service in them, than wounds in general. But the necessity for the practice is really not greater than in other wounds, which have done the same degree of mischief, and from which the same quantity of inflammation and other consequences are expected. Bleeding is certainly proper here, just as it is in all considerable wounds, attended with a strong full habit, and great chance of extensive inflammation, and much symptomatic fever. In every instance, however, the practitioner must take particular care not to be too bold in the practice of bleeding; for when the patient is reduced below a certain degree, his strength is inadequate to support the large and long-continued suppurations, which often cannot be avoided. (See *Hunter*, p. 563, 564.)

Gunshot wounds, in crowded military hospitals, especially when they are established in unhealthy, low, damp situations, and due attention is not paid to ventilation and cleanliness, are liable to be attacked by hospital gangrene, a most serious and dangerous complication. (See *Hospital Gangrene.*) Another formidable and generally fatal complication, is traumatic tetanus. (See *Tetanus.*) A third dangerous complication is *erysipelas*, particularly the phlegmonous kind.

The plan of removing the first dressings too soon is as injurious in gunshot wounds as other cases, by creating a premature disturbance of the parts. This observation is particularly true, where dry lint has been used, and it is adherent to the wound. Unless the occurrence of bleeding, severe pain, or other untoward symptoms, were to render a different line of conduct necessary, I think such dressings should rarely be removed before the end of the fourth day. And if cold water has not been continually applied over the lint, so as to keep it moist, or if such lint has not been spread with some mild salve, or dipped in oil, I deem it a good rule to apply an emollient poultice over it the evening preceding the morning on which the dressings are to be first changed. By this means, they will be loosened, and admit of being taken away without pain or irritation. With the same view, plenty of warm water should be squeezed from a sponge, and allowed to fall upon the dressings. Pledgets of oil, or ointment, should generally be taken off earlier than dry lint, for they are less adherent, and, in warm weather, soon become rancid and irritating.

For a few days, the matter seldom assumes a healthy appearance; but as soon as the sloughs separate, it then becomes of a proper quality, and the wound is to be treated as a simple abscess. As Dupuytren remarks, when the patient has got through all the dangers of the earlier stages of gunshot wounds, hemorrhage, gangrene, phlegmonous erysipelas, tetanus, and other perils, still await him. The fractured bones unite with difficulty; sinuses and deep abscesses form in the limb; the periosteum becomes detached; the bones denuded; and attacked by necrosis. Nor is this all the mischief: fractures of bones, abounding in spongy texture, are liable to be complicated with inflammation of the cellulo-vascular membrane, investing the areolæ of that texture, and its numerous veins. This inflammation, which is always followed by necrosis, sometimes extends a great distance, and this more especially in cases where the ball has occasioned a violent concussion of the bone.

Sometimes the healing process does not commence though suppuration has prevailed a considerable time. On the contrary, notwithstanding the exhibition of tonics, and a generous diet, the suppuration ceases to proceed favourably, and the wound becomes unhealthy, and the matter thin. The bones show no disposition to unite, and the patient, reduced by hectic symptoms, is rapidly approaching dissolution. In this state, life may sometimes be preserved by amputation.

Of Amputation in Gunshot Wounds.

The 2d edition of this Dictionary, published in 1813, contained all the valuable observations of Baron Larrey in favour of *immediate* amputation, in every instance in which the operation is considered indispensable. Since then, the public have been favoured with several good practical books, in which the propriety and necessity of early or immediate amputation in such cases are urgently inculcated, and the truth of the doctrine is illustrated by additional facts. It is to be observed, however, that for during the last two hundred years, there have always been some advocates for this judicious practice. "Du Chesne (says Dr. J. Thomson) is the first writer on military surgery, in whose works I have found the recommendation to amputate in the severer injuries of the extremities; and it is worthy of remark, that *he directs the operation to be performed before inflammation and other constitutional symptoms* shall have supervened." (See *Traité de la Cure générale et particulière des Arcbusades, par Jos. Du Chesne*, Paris, 1624, p. 143.; and *Thomson's Report, &c.* p. 160.) Wiseman not only recommended and practised immediate amputation, but the same thing was not unfrequently done by the military surgeons of his time. (*Chirurgical Treatises, by R. Wiseman*, 3d ed. Lond. 1696, p. 410.) The celebrated Le Dran, in his excellent little manual of military surgery, declared himself an advocate for *immediate* amputation, in all cases in which that operation from the first appears to be indispensable. Le Dran has, at the same time, stated briefly, but most distinctly, the comparative advantages of that practice, with those which may be expected by delay. (See *Traité ou Réflexions tirées de la Pratique sur les Plaies d'Armes à feu, par H. F. Le Dran*, à Paris, 1737.) Ranby, who was serjeant-surgeon to King George II., entertained similar opinions to those of Le Dran, with regard to the utility of immediate amputation. In order to give immediate relief to the wounded, and to facilitate the performance of the necessary operations, Ranby proposed, that the surgeons, during battle, should be collected into small bodies, and stationed in the rear of the army. (See *The Method of treating Gunshot Wounds, by John Ranby*, ed. 3. p. 29. Lond. 1781.)

After the battle of Fontenoy, in the year 1756, the Royal Academy of Surgery in France offered a prize for the best dissertation on the gunshot injuries requiring immediate amputation, and on other cases of the same nature, where the operation, though deemed inevitable, might be delayed.— "*L'amputation étant absolument nécessaire dans les plaies compliquées de fracas des os, et principalement celles qui sont faites par armes à feu, determiner les cas où il faut faire l'opération sur le champ, et ceux où il convient de la différer, et en donner les raisons.*" The prize was adjudged to M. Faure, the main object of whose paper was to recommend delaying the operation. This side of the question has found some modern advocates of distinguished talents and celebrity. Suffice it to mention the names of Hunter, Baron Percy, and Lombard. It is, however, only justice to M. Faure to state, that, though he regarded immediate amputation as full of danger, he admitted that there were several kinds of injuries of the extremities, in which it was indispensably and immediately required. "The enumeration (says Dr. Thomson) which this author has given of these injuries is more full and distinct than any which had been published before his time; and, what may appear singular, *it does not differ, in any essential respect, from the enumerations given by later writers*, who, in combating his opinions, have represented him as an enemy to amputation in almost all injuries of the extremities." (See *Obs. made in the Military Hospitals in Belgium*, p. 169.)

In 1792, Baron Percy, who was a few years ago at the head of the medical department of the French army, published a book, in which he gives a preference to delaying amputation at first, even in cases where it is certain that the operation cannot ultimately be dispensed with. (See *Manuel de Chirurgien d'Armée.*) So late as 1804, Lombard, professor in the Military Academy of Strasburg, defended the doctrines of M. Faure. (See *Clinique Chir. des Plaies faites par Armes à feu.*)

Although, in France, the Academy of Surgery thought proper to decree the prize to M. Faure, whose doctrine thus received the highest approbation, yet, in that country, very opposite tenets were set up by some men of distinguished talents and extensive military practice. Thus Le Dran, in his work on gunshot wounds, published in 1737, expressly states, "That when the amputation of a limb is indispensably necessary in the case of a gunshot wound, it ought to be done without delay." (*Aphorism* 9.) De la Martinière in particular also wrote some excellent arguments in reply to Bilguer; arguments which, I think, would do honour to the most accomplished surgeon of the age in which we live. (*Sur le Traitement des Plaies d'Armes à feu, in Mém. de l'Acad. de Chir.* t. xi. p. 1. edit. in 12mo.) M. Boucher, of Lisle, was an advocate for the same side of the question. (See *Obs. sur des Plaies d'Armes à feu, &c.*, in *Mém. de l'Acad. de Chirurgie*, tom. v. p. 279. &c. edit. in 12mo.) Schmucker, who was many years surgeon-general to the Prussian armies, published in 1776 an essay on amputation, in which he particularly mentions, that, during his stay at Paris, in 1738, the surgeons of the Hôtel-Dieu had been in the habit of performing immediate amputation in severe injuries of the extremities. *He also declares himself an advocate for operating immediately in all cases, in which amputation from the first appears to be necessary*, and insists, in a particular manner, on the increased danger which he had seen arise from the operation during the second period. He gives (as Dr. J. Thomson has observed) a minute and circumstantial enumeration of those injuries, both of the upper and lower extremities, in which he conceived amputation to be necessary, and in many of which he had actually performed it with great success. Schmucker appears to Dr. Thomson to have given a better account, than any preceding military surgeon, of the injuries of the thigh; and from the results of his experience, he was led to believe, that, *though compound fractures of the lower part of the thigh-bone might, in favourable circumstances, be cured without amputation, yet that this operation is peculiarly necessary in all cases in which the fracture is situated in or above the middle of that bone. (J. L. Schmucker, Vermischte Chirurgische Schriften*, b.i. Berlin, 1785.) With the foregoing high authority we have to join one of not less celebrity, namely, that of Baron Larrey, who has proved most convincingly, that when amputation is to be done in cases of gunshot wounds, nothing is so pernicious as delay. (See *Mém. de Chir. Militaire*, t. ii. p. 451. &c.)

The principles inculcated by Baron Larrey are, in point of fact, the same as those which were so strenuously insisted upon by Pott, whose principal remarks on the necessity of amputation in certain cases, are detailed in another part of this publication. (See *Amputation.*) Pott, indeed, was not an army-surgeon, and what he says was not particularly designed to apply to military practice; but he has represented, as well as any body can do, the propriety of immediate amputation for injuries, which leave no doubt that such operation cannot be dispensed with.

Mr. John Bell, amongst the moderns, appears likewise to have much merit, for the able manner in which he defended the propriety of early amputation, long before the sentiments of later writers were ever heard of. He distinctly states, that "amputation should, in those cases where the limb is plainly and irrecoverably disordered, be performed upon the spot." (See *Discourses on the Nature, &c. of Wounds*, p. 488. edit. 3.) In short, notwithstanding all the modern pretensions to novelty upon this interesting topic, we must acknowledge, with Dr. Thomson, that the evidence in favour of the advantages of immediate amputation has always preponderated over that for delay. (See *Report of Obs. &c.* p. 225.)

The strongest body of evidence upon this matter, is undoubtedly adduced by Baron Larrey, whose situation, at the head of the surgical department of the French armies, afforded him most numerous opportunities of judging from actual experience. "Upon this subject (says he), now that twenty years of continual war have carried our art to the highest pitch of perfection, there can only be one opinion. It is after having incessantly directed the medical service all this time, in quality of head-surgeon and inspector-general of the armies, that I proceed to discuss the different opinions delivered in the Academy, and to settle definitively this great question, which I regard as the most important in military surgery.

"If we are to be told that the amputation of a limb is a cruel operation, dangerous in its consequences, and always grievous for the patient, who is thereby mutilated; that, consequently, there is more honour in saving a limb, than in cutting it off with dexterity and success; these arguments may be refuted by answering, that amputation is an operation of necessity, which offers a chance of preservation to the unfortunate, whose death appears certain under any other treatment; and, that if any doubt should exist of amputation being absolutely indispensable to the patient's safety, the operation is to be deferred, till nature has declared herself, and given a positive indication for it. We are also justified in adding, that this chance of preservation is at the present day much greater, than at the epoch of the Academy of Surgery. We learn from M. Faure, that of about three hundred amputations, performed after the battle of Fontency, only thirty were followed by success, whilst on the contrary (says Baron Larrey), we have saved more than three-fourths of the patients, on whom amputation has been done, and some of whom also had two limbs removed." This improvement is ascribed by Larrey, 1. To our now knowing better how to take advantage of the indication and favourable time for amputating. 2. To the better method of dressing. 3. To the mode of operating being more simple, less painful, and more expeditious, than that formerly in vogue.

To the preceding authorities against delaying amputation, in cases of gunshot wounds requiring such operation, I have to add Mr. Guthrie, whose opportunities of observation, during the late war in Spain, were particularly extensive. In his work he has detailed the opinions of many eminent foreign and British surgeons, respecting the propriety, or impropriety, of the doctrine of immediate amputation; and he has introduced some good criticisms, particularly on Bilguer's statement of the success, which was experienced in the Prussian hospitals, from not performing the operation. Mr. Guthrie, however, does not recommend amputation to be done immediately, if the patient be particularly depressed by the shock of the injury directly after its receipt; a piece of advice which I believe has in reality been at all times followed, not only in respect to amputations, in cases of gunshot wounds, but all other severe local injuries. "I believe it to be (says Mr. Guthrie), a stretch of fancy in those surgeons who concieve, that, if the knife followed the shot in all cases, the patient would have the best chance of success. No one will deny, that, if the shot performed a regular amputation, it would not be better than to have to do it afterwards: but, if they mean to say the operation should in general be performed immediately after the injury, I can only oppose to them the facts above stated, and the general result of my experience, which is decidedly in favour of allowing the first *moments* of agitation to pass over before any thing be done; a period extending from that to one, six, or eight hours, according to the difference of constitution, and the different injuries that have been sustained. But, *from one to three hours* will in most cases be found sufficient." (*On Gunshot Wounds*, p. 226. edit. 2. Lond. 1820.) In the first edition of this gentleman's book, some little want of precision rather concealed his exact meaning, with respect to the period of time, which should generally be allowed to transpire between the receipt of the injury and the performance of amputation; but after all the disposition to controversy upon this point, it appears there is little to fight about, as there is rather a misunderstanding than a difference of opinion. All acknowledge the advantage of doing the operation immediately, when the patient is not faint and depressed by the shock of the accident; all admit the prudence of deferring the use of the knife in other cases until the constitution has revived sufficiently to be capable of bearing the removal of the limb. (See *A. C. Hutchison, Pract. Obs. in Surgery,* 8vo. Lond. edit. 2. and his *Further Observations on the proper Period for Amputating in Gunshot Wounds,* 1817; *Quarrier,* in *Med. Chir. Trans.* vol. viii.; and *Dewar,* in *Med. Chir. Journ.* April 1819.)

"Formerly (observes one of the best surgeons which modern times has produced), military surgeons were accused of being too ready to amputate. The experience which I have had, chiefly in 1814, 1815, and 1830, have proved to me the little foundation for this reproach; how many disasters we should have to blame ourselves for, in declining too frequently to amputate; and I do not fear to lay it down as a principle, that, in complicated gunshot-fractures, a greater number of individuals are lost by deferring the operation, than that of limbs saved." (*Dupuytren,* in *Clin. Chir.* t. iv. p. 238.) This important remark is followed by the particulars of cases, illustrative of its truth. (See also *H. Larrey, Hist. Chir. du Siége d'Anvers,* p. 250.; and *A. L. M. Velpeau, Nouv. Elém. de Méd. Opér.* t. i. p. 282. *et seq.*)

So far as my experience goes, when the necessity of amputation is undoubted, all delay is improper beyond the short period during which the faintness immediately arising from the injury usually lasts. In the campaign in Holland, 1814, the most successful amputations were those done in the field-hospitals directly after the arrival of the patients, or rather, as Dr. Hennen has expressed it, with as little delay as possible. "While hundreds are waiting for the decision of the surgeon, he will never be at a loss to select individuals, who can safely and advantageously bear to be operated upon, as quickly as himself or assistants can offer their aid; but he will betray a miserable want of science, indeed, if, in this crowd of sufferers, he indiscriminately amputates the weak, the terrified, the sinking, and the determined. While he is giving his aid to a few of the latter class, encouragement and a cordial will soon make a change in the state of the weakly or the terrified; and a longer period and more active measures, will render even the sinking proper objects for operation." (*On Military Surgery,* p. 45. ed. 2.) It appears from some returns collected by Mr. Guthrie, that in the Peninsular the comparative loss, in secondary or delayed operations, and in primary or immediate amputations, was as follows: —

	Secondary.		Primary.
Upper extremities . . .	12	to . .	1
Lower extremities	3	to . .	1

The great success attending amputation on the field of battle, was also convincingly proved after the battle of Toulouse. Here, of 47 immediate amputations, 38 were cured, while of the 51 delayed operations, on that occasion, 21 had fatal terminations. (P. 42—44, ed. 1.) After the attack on New Orleans, out of 45 primary amputations, 38 patients recovered, while only 2 of 7 secondary amputations terminated in the preservation of the patients. (*Op*. cit., p. 294, edit. 2.)

Of immediate Amputation.

When a limb that has received a gunshot wound cannot be saved, amputation should be immediately practised. The first four-and-twenty hours, Baron Larrey observes, are the only time that nature remains tranquil (I should say, she does not remain quiet so long), and we must hasten to take advantage of this period.

In the army, a variety of circumstances make the urgency for amputation still greater. 1. The inconvenience attending the transport of the wounded from the field of battle to the military hospitals, in carriages badly suspended, the jolting of which would produce such disorder in the wound, and in the whole body, that most patients would die in the journey, especially if it were long, and the weather either extremely hot or cold.

2. The danger of a long continuance in the hospitals; a danger which amputation materially diminishes, by changing a gunshot injury into a wound that may be speedily healed, and reducing the causes of fever, and hospital gangrene.

3. The cases in which there is a necessity for abandoning the wounded. In this circumstance, it is of importance to have amputated; for, after the operation, the patients may remain some days without being dressed, and the dressings are afterwards more easy.

Of cases in which Amputation should be done immediately.

First case.— A limb carried away by a cannon-ball, or the explosion of a howitzer, or bomb, requires amputation without loss of time: the least delay puts the patient's life in danger. In this case, the necessity of the practice is inculcated by M. Faure himself, as well as by Schmucker, Richter, Larrey, Dr. Thomson, H. Larrey, junior, (*Hist. Chir. du Siége d'Anvers*, p. 263.), and every judicious writer upon gunshot wounds.

When a cannon-ball has torn off a limb, amputation of the stump should be performed, in order to procure the patient an even, smooth incision, instead of an irregular, jagged, and highly dangerous wound. As the limb has commonly suffered a violent concussion, is almost bereft of sense, and power of motion, and the bone frequently has a fissure extending some way upward, amputation is sometimes recommended to be done, if possible, above the nearest joint. Were the operation not done, this kind of injury would require large and free incisions, for the extraction of foreign bodies, the shortening of projecting muscles and tendons, and the discharge of abscesses; and, as these incisions are likely to occasion at least as much irritation as amputation itself, without being productive of equal good, the avoidance even of pain cannot be urged as a reason against the practice. The occasional healing of such wounds only proves, that it is not altogether impossible, in certain instances, to effect a cure without amputation. The surgeon can the more readily make up his mind to amputate, as, in this case, the operation does not occasion the loss of a limb. As for the place of the incision, no one would be justified in amputating above the knee, when the limb is injured at the foot or ankle.

The skin has been violently stretched and lacerated; the muscles have been ruptured and irregularly torn away; the tendons and aponeuroses lacerated; the nerves and vessels divided and forcibly dragged; lastly, the bones broken and smashed to a greater or lesser extent. These first effects are followed by a general, or partial commotion; by a kind of torpor in the injured part, and a good way above the wound; by a painful trembling in the remains of the limb, an event that is singularly afflicting to the patient; and by a local swelling preceding the erethismus, which quickly shows itself. The hæmorrhage, says Baron Larrey, an accident much more to be apprehended than has been supposed, often comes on a few moments after the injury, and, if prompt succour were not afforded, would put a period to the patient's existence. "I can even declare, that, had it not been for the activity of the train of light surgical carriages (*ambulances volantes*), by means of which the wounded have always been dressed upon the field of battle, many soldiers would have perished from this accident alone."

If the operation is not speedily done, pain commences, fever occurs, and the functions of the system become disordered · the irritation then increases, and convulsive motions take place. If the patient should not be a victim to these first symptoms, gangrene of the stump follows, the fatal consequences of which it is extremely difficult to prevent.

After this short exposition, it is easy to see, that, in this case, amputation ought to be practised immediately, and to delay the operation, and merely apply simple dressings, would be affording time for the bad symptoms to come on.

At Strasburg, during the bombardment of the fort of Kell, in 1792, three volunteers, says Baron Larrey, had limbs shot off by the explosion of shells: one, an arm; another, a fore-arm; and the third, a leg. They were conveyed to the hospital for the wounded in that town, which was superintended by M. Boy. Several days were suffered to elapse before amputation was performed: not one of the patients escaped. At Mentz, after the retreat from Frankfort, several of the wounded, who had had limbs shot off, did not have amputation performed till some time afterwards, and not one of them recovered. At Nice, after the taking of Saourgio, two amputations were practised at the hospital, No. 2, one of the fore-arm, the other of the arm, nine or ten days after the receipt of the injuries: both the patients died. At Perpignan, Baron Larrey visited two soldiers, on whom amputation had been done, seven or eight days after the receipt of gunshot injuries in the action of the 14th of July, 1794. One had had a leg shot off, and the other his right arm. Notwithstanding Larrey's utmost care, he could not save their lives: one died of tetanus; the other of gangrene.

In the month of August, 1805, two cannoniers of the guards, in discharging the artillery, had each a hand shot away, and all the fore part of their bodies burnt. These were the two men, whose office it was to charge the gun. At the moment when they had just rammed down the wad on the cartridge, a spark that had been left unextinguished, from the neglect to keep the touchhole closed, set fire to the powder: the ramrod was violently repelled by the explosion, together with every thing that was situated in front of the charge. The right hand of one of these soldiers was completely torn off, between the two phalanges of the carpus, and thrown more than two hundred paces. The countershock even threw him down into the ditch of the square of the Hôtel des Invalides. The left hand of the other was torn away, together with the fore-arm at the elbow-joint, and also forced to a considerable distance. The tendons and muscles sustained vast injury, and the worst symptoms would have occurred, if amputation had not been instantly performed. In one case, amputation was done at the wrist; and, in the other, at the lower third of the arm. The two operations were followed by complete success, although the burns upon the face and chest, in both the patients, were serious and extensive.

Second case. — When a body, propelled by gunpowder, strikes a limb, in such a manner as to smash the bones, violently contuse, lacerate, and deeply tear away, the soft parts, amputation ought to be immediately performed. If this measure be neglected, all the injured parts will soon be seized with gangrene: and besides, as Larrey has explained, the accidents, which the gravity of the first case produces, will also here be excited. It is only doing justice to the memory of M. Faure to state, that this second case was one, which he also particularly instanced as demanding the immediate performance of amputation. (See *Prix de l'Acad. Royale de Chirurgie*, t. viii. p. 23. éd. 12mo.)

Third case. — If a similar body were to carry away a great mass of the soft parts, and the principal vessels of a limb (of the thigh, for instance), without fracturing the bone, the patient would be in a state demanding immediate amputation; for, independently of the accidents which would originate from a considerable loss of substance, the limb must inevitably mortify. Mr. Guthrie, also says, "A cannon-shot destroying the artery and vein, on the inside (of the thigh), without injuring the bone, requires amputation." (P. 185.) When, however, the femoral artery, or vein, is injured by a musket-ball, or small canister-shot, this gentleman recommends tying the vessel above and below the wound in it, if the nature of the case be evinced by hæmorrhage. But, he believes, that when both vein and artery are injured, amputation is necessary. (P. 186.) With respect to bleeding from the femoral vein, as it may easily be stopped by moderate pressure, the propriety of using any ligature at all is questionable.

"An injury of the femoral artery (observes Mr. Guthrie), requiring an operation, accompanied with fracture of the bone of the most simple kind, is a proper case for immediate amputation; for, although many patients would recover from either accident alone, none would, I believe, surmount the two united; and the higher the accident is in the thigh, the more imperious is the necessity for amputation." (*Guthrie on Gunshot Wounds*, p. 187.)

Fourth case. — A grape-shot strikes the thick part of a member, breaks the bone, divides and tears the muscles, and destroys the large nerves, without, however, touching the main artery. According to Larrey, this is a fourth case, requiring immediate amputation.

Mr. Guthrie seems to coincide on this point with Larrey: "If a cannon-shot strike the back part of the thigh, and carry away the muscular part behind, and with it the great sciatic nerve, amputation is necessary, even if the bone be untouched, &c. In this case, I would not perform the operation by the circular incision, but would preserve a flap from the forepart, or sides, as I could get it, to cover the bone, which should be short." (*Guthrie on Gunshot Wounds of the Extremities*, p. 184.)

Fifth case. — If a spent cannon-shot, or one that has been reflected, should strike a member obliquely, without producing a solution of continuity in the skin, as often happens, the parts which resist its action, such as the bones, muscles, tendons, fasciæ, and vessels, may be ruptured and crushed. The extent of the internal disorder is to be examined; and if the bones should feel, through the soft parts, as if they were smashed, and if there should be reason to suspect, from the swelling, and a sort of fluctuation, that the vessels are lacerated, amputation ought to be immediately practised. This is also the advice of Baron Percy. Sometimes, however, the vessels and bones escape injury, and the muscles are almost the only parts disordered. In this circumstance, we are enjoined to follow the counsel of De La Martinière, who recommended making an incision through the skin. By this means, a quantity of thick blackish blood will be discharged, and the practitioner must await events. According to Larrey, such incision is equally necessary in the preceding case, previously to amputation, in order to ascertain the extent of mischief.

It is to such injury, done to internal organs, that we must ascribe the death of many individuals, which was for a long while attributed to the commotion produced in the air. (See *Ravaton, Traité des Plaies d'Armes à feu.*)

The incorrectness of this opinion we may easily convince ourselves of, if we carefully consider, 1st, the direction and course of solid hard bodies, and their relation to the air, through which they have to pass; 2dly, the internal disorder observable in the dead bodies of persons, whose death is imputed to the mere impression of the air, agitated by the ball; 3dly, the properties of the elastic substances, such as the integuments, cellular substance, &c. struck by the shot. It is universally agreed amongst philosophers, that a solid body, moving in a fluid, only acts upon a column of this fluid, the base of which column is nearly equal to the surface which the solid body presents. (See *Le Vacher sur quelques Particularités concernant les Plaies faites par Armes à feu, in Mém. de l'Acad. de Chirurgie*, t. xi. p. 34. éd. 12mo.)

Thus a cannon-ball, in traversing a space equal to its diameter, can only displace a portion of air, in the relation of 3 to 2, compared with the size of the shot. This fluid, in consequence of its divisibility and homogenealness with the ambient air, is dispersed in all directions, and confounded with the total mass of the atmosphere. The effects of this aeriform substance amount to nothing, and not a doubt can be entertained, that if there is the slightest solution of continuity of any part of the body, it must depend upon the direct action of the ball itself.

The different movements which the ball describes in its course, and the elasticity of the skin, enable us to explain how internal injuries are produced, without any external solution of continuity, and often even without ecchymosis. The motion communicated to the ball by the power which projects it, is, for a given space, rectilinear. If, at this distance, it strikes against the body, it carries the part away to an extent proportioned to the mass with which it touches the part. But, the ball, after having traversed a certain distance, undergoes, in consequence of the resistance of the air, and the attraction of gravity, a change of motion, and now turns on its own axis, in the diagonal direction.

If the shot should strike any rounded part of the body, towards the end of its course, it will run round a great portion of the circumference of the part, by the effect of its curvilinear movement. It is also in this manner, observes Larrey, that the wheel of a carriage acts, in passing obliquely over the thigh, or leg, of an individual stretched upon the ground. In this case, the results are the same as those of which we have been speaking. The most elastic parts yield to the impulse of the contusing body; while such as offer resistance, as, for instance, the bones, are fractured; and tendons, muscles, and aponeuroses, ruptured or lacerated. Sometimes the viscera are similarly injured.

At first sight, all the parts appear to be entire; but a careful examination will not let us remain long in doubt about the internal mischief. In this case, an ecchymosis cannot manifest itself outwardly, because the extravasation of blood naturally takes place in the deep excavations occasioned by the rupture of the muscles and other parts, and because this fluid cannot make its way through the texture of the skin. Such extravasations can only be detected by the touch.

The foregoing reasoning is supported by experience. How often, says Larrey, have we not seen the ball carry away pieces of helmets, hats, cartridge-boxes, knapsacks, or other parts of the soldier's dress, without doing any other injury? The same ball, perhaps, takes off his arm, often at a time when it is closely applied to the body of his comrade, and yet the latter does not receive the slightest harm. The shot may pass betwixt the thighs, and these members hardly exhibit an ecchymosis at the points, which are gently grazed; the only example in which ecchymosis does occur. In other instances, the ball severs the arm from the trunk, and the functions of the thoracic viscera are not at all injured.

Baron Larrey then relates the following case, which is analogous to one which I saw near Antwerp, and have already mentioned in the foregoing columns. M. Méget, a captain, marching in the front of a square of men, in the heat of the battle of Altzey, 30th March, 1793, had his right leg almost entirely carried away by a large cannon-shot, without the contiguous limb of his lieutenant, who was as close as possible to him, receiving the least injury. The violent general commotion excited, and the extreme severity of the weather, made this officer's condition imminently perilous. The progress of the symptoms, however, was checked by amputation, which was instantly performed. M. Méget was then conveyed to the hospital at Landau, fifteen leagues from the field of battle, where he got quite well.

Larrey declines relating numerous other analogous amputations, which he has been called upon to practise under the same circumstances. M. Buffy, a captain of the artillery of the army of the Rhine, was struck by a howitzer, his left arm being injured, and his head so nearly grazed, that the corner of his hat, which was placed forwards over his face, was shot away as far as the crown. This officer, the skin of whose nose was even torn off, was not deprived of his senses, and he was actually courageous enough to continue for some minutes commanding his company. At length he was conveyed to Larrey's *ambulance*, who amputated his arm: in about a month the patient was well.

Larrey expresses his belief, that what have been erroneously termed *wind contusions*, if attended with the mischief above specified, require immediate amputation. The least delay makes the patient's preservation extremely doubtful. The internal injury of the member may be ascertained by the touch, by the loss of motion, by the little sensibility retained by the parts, which have been struck; and, lastly, by practising an incision, as already recommended.

At the siege of Rosas, two cannoniers, having nearly similar wounds, were brought from the trenches to the ambulance, which Baron Larrey had posted at the village of Palau. They had been struck by a large shot, which, towards the termination of its course, had grazed posteriorly both shoulders. In one, Larrey perceived a slight ecchymosis over all the back part of the trunk, without any apparent solution of continuity. Respiration hardly went on, and the man spit up a large quantity of frothy vermilion blood. The pulse was small and intermitting, and the extremities were cold. He died an hour after the accident. Baron Larrey opened the body, in the presence of M. Dubois. The skin was entire; the muscles, aponeuroses, nerves, and vessels of the shoulders were ruptured and lacerated, the scapulæ broken in pieces, the spinous processes of the corresponding dorsal vertebræ, and the posterior extremities of the adjacent ribs, fractured. The spinal marrow had suffered injury; the neighbouring part of the lungs was lacerated, and a considerable extravasation had taken place in each cavity of the chest.

The second artilleryman died of similar symptoms, three quarters of an hour after his arrival at the hospital. On opening the body, the same sort of mischief was discovered.

Sixth case.—According to Baron Larrey, when the articular heads of bones are much broken, especially those which form the joints of the foot, or knee, and the ligaments, which strengthen these articulations, are lacerated, by the fire of a howitzer or a grape-shot, or other kind of ball, immediate amputation is indispensable. The same indication would occur, were the ball lodged in the thickness of the articular head of a bone, or were it so engaged in the joint, as not to admit of being extracted by simple and ordinary means. (See also *Guthrie on Gunshot Wounds*, p. 197.)

Fractures extending into the joints, and accompanied with great laceration of the ligaments, were cases of gunshot injuries pointed out by M. Faure as indispensably requiring immediate amputation. (See *Prix. de l'Acad. de Chir.* t. viii.) Thus we see that this author was not so averse to early amputation as several modern writers have represented. If the voice of experience be not listened to, and amputation be deferred, the parts become disorganised, and the patient's life is put into imminent peril.

It is evident, says Larrey, that in this case, if we wish to prevent the patient from dying of the subsequent symptoms, amputation should be performed before twelve, or at most twenty-four, hours have elapsed. (*Mém. de Chir. Militaire*, t. ii.)

With respect to wounds of the knee, the sentiments of Mr. Guthrie nearly coincide with those of Larrey. "I most solemnly protest (says Mr. G.) I do not remember a case do well, in which I knew the articulating end of the femur, or tibia, to be fractured by a ball that passed through the joint, although I have tried great numbers, even to the last battle of Toulouse. I know that persons, wounded in this way, have lived; for a recovery it cannot be called, where the limb is useless, bent backward, and a constant source of irritation and distress, after several months of acute suffering, to obtain even this partial security from impending death; but, if one case of recovery should take place in fifty, is it any sort of equivalent for the sacrifice of the other forty-nine? Or is the preserving of a limb of this kind an equivalent for the loss of one man?" (*On Gunshot Wounds*, p. 196.)

In the attack of the village of Merksam near Antwerp, early in 1814, a soldier of the 95th regiment was brought to our field-hospital, having received a musket-ball through the knee-joint. The staff-surgeons on duty, and Mr. Curtis, surgeon of the 1st guards, were preparing to amputate the limb, when a surgeon, attached to the 95th, urgently recommended deferring the operation. Superficial dressings were applied, and the patient sent to the rear. He lived several months after the accident, at times affording hopes of a perfect recovery; but, in the end, he fell a victim to hectic symptoms.

Indeed, such is the general unfortunate result of these cases, that Dr. Hennen lays it down as a rule in military surgery, that no lacerated joint, particularly the knee, ankle, or elbow, should ever leave the field unamputated, where the patient is not obviously sinking. (*On Military Surgery*, p. 41. ed. 2.)

According to Mr. Guthrie, fractures of the patella, without injury of the other bones, admit of delay, provided the bone is not much splintered.

Seventh case.— Larrey observes, that if a grape shot, a small cannon-shot, or a piece of a bombshell, in passing through the substance of a member, should have extensively denuded the bone, without breaking it, amputation is equally indicated, although the soft parts may not appear to have particularly suffered. Indeed, the violent concussion, produced by the accident, has disorganised many parts; the medullary substance is injured, the vessels are lacerated, the nerves immoderately stretched, and thrown into a state of stupor; the muscles are deprived of their tone; and the circulation and sensibility in the limb are obstructed. Before we decide, however, Baron Larrey cautions us to observe attentively the symptoms which characterise this kind of disorder. The case can be supposed to happen only in the leg, where the bone is very superficial, and merely covered at its anterior part with the skin.

The following are described as the symptoms: the limb is insensible, the foot cold as ice, the bone partly exposed, and, on careful examination, it will be found, that the integuments, and even the periosteum, are extensively detached from it. The commotion extends to a considerable distance; the functions of the body are disordered; and all the secretions experience a more or less palpable disturbance. The intellectual faculties are suspended, and the circulation is retarded. The pulse is small and concentrated; the countenance pale; and the eyes have a dull moist appearance. The patient feels such anxiety, that he cannot long remain in one posture, and requests that his leg may be quickly taken off, as it incommodes him severely, and he experiences very acute pain in the knee. When all these characteristic symptoms are conjoined, says Larrey, we should not hesitate to amputate immediately; for otherwise, the leg will be attacked with sphacelus, and the patient certainly perish.

Larry adduces several interesting cases in support of the preceding observations.

Eighth case.— When a large ginglymoid articulation, such as the elbow, or especially the knee, has been extensively opened with a cutting instrument, and blood is extravasated in the joint, Larrey deems immediate amputation necessary. In these cases, the synovial membranes, the ligaments and aponeuroses, inflame, the part swells, erethismus rapidly takes place, and acute pains, abscesses, deep sinuses, caries, febrile symptoms, and death, are the speedy consequences. Larrey has seen numerous subjects die of such injuries, on account of the operation having been postponed through a hope of saving the limb. In his *Mém. de Chir. Militaire*, t. ii. some of these are detailed. Several facts of the same kind are candidly recorded by M. Velpeau. (See *Nouv. Elém. de Méd. Opér.* t. i. p. 284.)

Although a wound may penetrate a joint, yet, if it be small, and unattended with extravasation of blood, M. Larrey informs us, it will generally heal, provided too much compression be not employed. This gentleman believes in the common doctrine of the pernicious effect of the air on the cavities of the body; yet, in this place, a doubt seems to affect him: for, in speaking of the less danger of small wounds of joints, he says, "*à quoi tient cette différence, puisque l'air pénètre dans l'articulation dans l'un comme dans l'autre cas?*"

When two limbs have been at the same time so injured, as to require amputation, we should not be afraid of amputating them both immediately, without any interval. We have, says Larrey, several times performed this double amputation with almost as much success as the amputation of a single member. He has recorded an excellent case in confirmation of this statement. (*Mém. de Chir. Militaire*, t. ii. p. 478.)

When a limb is differently injured at the same time in two places, and one of the wounds requires amputation (suppose a wound of the leg with a splintered fracture of the bone, and a second of the thigh, done with a ball, but without any fracture of the os femoris, or other bad accident,) Larrey recommends us first to dress the simple wound of the thigh, and amputate the leg immediately afterwards, if the knee be free from injury. When it is necessary to amputate above this joint, the less important wound need not be dressed, till after the operation, provided it can be comprehended in the section of the member, or be so near the place of the incision as to alter the indication. When the wound demanding amputation is the upper one, the operation of course is to be done above it, without paying any regard to the injury situated lower down.

Ninth case. — To the foregoing species of gunshot wounds, pointed out by Baron Larrey as urgently requiring immediate amputation, my own experience, and the observations of Dr. Thomson, justify me in adding compound fractures of the thigh from gunshot violence. I am particularly glad that the latter gentleman has devoted a proper degree of attention to these cases; for the opportunities which I had of judging when abroad, incline me to believe, that military surgeons are hardly yet sufficiently impressed with the propriety of immediate amputation in gunshot fractures of the thigh. There were brought into my hospital at Oudenbosch, in 1814, about eight of such cases, all in the worst state for an operation, because several days had elapsed after the receipt of the injuries. All these patients died, excepting one, whose fracture was not far above the condyles, and I do not know, that he ever regained a very useful limb. Another had indeed been rescued by amputation from the dangers of the injury; but was, unfortunately, lost by secondary hemorrhage about three days after the operation. The bleeding was almost instantly suppressed; yet such was the weakness of the patient, that the irritation of securing the vessel, and the loss of blood together, destroyed at once every hope of recovery. Were I to judge then, from my own personal observations in the army, and from some other cases, which I saw under my colleagues, I should, without hesitation, recommend immediate amputation in all cases of compound fractures of the thigh, caused by grape-shot, musket-balls, &c. If there are any exceptions to this advice, they are such as are specified in the article AMPUTATION.

"Gunshot fractures of the thigh (says Dr. J. Thomson) have been universally allowed to be attended with a high degree of danger; indeed, till of late years, very few instances have been recorded of recovery from these injuries. Ravaton acknowledges, that in his long and extensive experience, he had never seen an example of recovery from a gunshot fracture of the thigh; and Bilguer, in his calculations, with regard to those who recover from gunshot fractures, sets aside those of the thigh-bone as being of a nature altogether hopeless. In the present improved state of military surgery, instances sometimes occur of recovery from this fracture; but, of these, the number will be found, I believe, to be exceedingly small, in comparison with those who die, particularly when the fracture has had its seat above the middle of the bone.

According to the observation of Percy, scarcely two of ten recover, who have suffered gunshot fractures of the thigh-bone. Mr. Guthrie, who seems to have paid great attention to this subject, says, that "upon a review of the many cases which I have seen, I do not believe, that more than one-sixth recovered, so as to have useful limbs; two-thirds of the whole died either with or without amputation; and the limbs of the remaining sixth were not only nearly useless, but a cause of much uneasiness to them for the remainder of their lives." (See *Guthrie on Gunshot Wounds*, p. 191.)

"In fractures by musket-bullets of the lower part of the thigh-bone (says Dr. Thomson) recovery not unfrequently takes place; and both Schmucker and Mr. Guthrie conceive that they are injuries in which amputation may be delayed with safety. It would be very agreeable that this opinion should be confirmed by future experience; but it appears to me, that, before it can be received as a maxim in military surgery, much more extensive and accurate observation than we yet possess, will be required, with regard to the proportion of those who recover without amputation, or after secondary operations, and of those who recover after primary amputation. Of those who had suffered this injury, we saw, comparatively, but a small number recovering in Belgium, and they had been attended with severe local and constitutional symptoms." (See *Obs. made, &c. in Belgium*, p. 247. *et seq.*)

In the article AMPUTATION, I have described the manner in which balls produce fissures of several inches in length in the thigh-bone. This state of the bone, observes Dr. Thomson, must be very unfavourable to recovery, and his conclusion is, that, in general, even in fractures of the lower part of the thigh-bone, a greater number of lives will be preserved in military practice, by immediate amputation, than by attempting the cure, without that operation. "When the bone appears, on a careful examination, to be broken without being much splintered, and when the patient can be removed easily to a place of rest and safety, it may be right to attempt to preserve the limb; but if the bone be much splintered, or if the conveyance is to be long or uncertain, it will, in most instances, I am convinced, be a much safer practice, even in fractures of this part of the thigh-bone, to amputate without delay.

"Musket-bullets, in passing through the femur, near to the knee-joint, produce fissures of the condyles, which generally communicate with the joint. These cases, like those, in which the bullets have passed directly through the joint, require immediate amputation.

"The writings of military surgeons contain but few histories of cases, in which the thigh-bone had been fractured above its middle by the passage of musket-bullets. These are cases, I believe, which have generally had a fatal termination; and the danger attendant upon the amputation which they require, seems long to have deterred surgeons from attempting to ascertain what advantages might be derived from the employment of that operation. Schmucker recommends, and states that he had practised with success, immediate amputation in those cases, in which a sufficient space was left below the groin for the application of the tourniquet. It is curious to remark, in the history of amputation, how long surgeons were in discovering the ease and safety with which the femoral artery might be compressed by the fingers, or pads, in its passage over the brim of the pelvis. M. Boy, from the immediate danger, protracted suffering, and ultimate want of success, which he had observed to follow this kind of injury, urges strenuously the propriety of immediate amputation. Mr. Guthrie's opinion, with regard to the dangerous nature of these injuries, and the advantages to be derived in them from immediate amputation, coincides in every respect with those of Schmucker and Boy. He observes, that those whose thigh-bone has been fractured in its upper part by a musket-bullet, generally die with great suffering, before the end of the sixth or eighth week; and that few even of those escape, in whom that bone has been fractured in its middle part. Of the few whom we saw, who had survived gunshot fractures in the upper part of the thigh-bone in Belgium, scarcely any one could be said to be in a favourable condition. In all, the limbs were much contracted, distorted, and swollen, and abscesses had formed round and in the neighbourhood of the fractured extremities of the bones. In some instances, these abscesses had extended down the thigh; but more frequently they passed upwards, and occupied the region of the hip-joint and buttocks. In several instances, in which incisions had been made for the evacuation of matter, the fractured and exfoliating extremities of the bones, sometimes comminuted, and sometimes forming the whole cylinder, could be felt bare, rough, and extensively separated from the soft parts which surrounded them. In other instances, these extremities were partially enclosed in depositions of new bone, which, from the quantity thrown out, seemed to be present in a morbid degree. It was obvious that, in all of these cases, several months would be required for the reunion of the fractured extremities; that, in some, much pain and misery was still to be endured from the processes of suppuration, ulceration, exfoliation, and ejection of dead bone; that, in some cases, the patients were incurring great danger from hectic fever, and from diarrhœa: that the ultimate recovery in most of them was doubtful, and that of those, in whom this might take place, there was but little probability that any would be able to use their limbs! The sight of these cases (says Dr. Thomson) made a deep impression upon my mind, and has tended to increase my conviction, that this is, of all others, the class of injuries in which immediate amputation is most indispensably required." (See *Obs. &c. in Belgium*, p. 254—258.)

Dr. Thomson adds, that what has been said of the danger of fractures, produced by musket-bullets, in the upper part of the femur, is true in a still greater degree of those, which have their seat in the neck or head of that bone. In such instances, Dr. Thompson joins the generality of modern army surgeons in strongly recommending amputation at the hip joint; a subject, of which I have already spoken. (See AMPUTATION.)

ON GUNSHOT WOUNDS, IN WHICH AMPUTATION MAY BE DEFERRED.

If, says Baron Larrey, it be possible to specify the cases in which amputation ought to be immediately performed, it is impossible to determine *à priori* those, which will require the operation subsequently. One gunshot wound, for example, will be cured by ordinary treatment, while another, that is at first less severe, will afterwards render amputation indispensable, whether this be owing to the patient's bad constitution, or the febrile disturbance induced. However this may be, the safe rule for fulfilling the indication that presents itself, is to amputate consecutively only in circumstances in which every endeavour to save the limb is manifestly in vain. Upon this point Larrey's doctrine differs from that of Faure.

The latter practitioner admits cases, which he terms cases *of the second kind*, in which he delays amputation, not with any hope of saving the limb, but in order to let the first symptoms subside. The operation, done between the fifteenth and twentieth day, appears to him less dangerous than when performed immediately after the receipt of the injury. At the above period, according to M. Faure, the commotion, occasioned by the gunshot injury, is dispelled; the patient can reconcile himself to amputation, the mere mention of which fills the pusillanimous with terror in a greater or lesser degree; the debility of the individual is no objection; and it is laid down as an axiom "that the consequences of every amputation, done in the first instance, are in general extremely dangerous." In support of this theory, M. Faure adduces ten cases of gunshot injuries, in which, after the battle of Fontenoy, the operation was delayed, in order that it might afterwards be performed with more success: a plan which, according to the author, proved completely successful. (See *Prix de l'Acad. de Chir.* t. viii. ed. in 12mo.)

This division of cases for amputation into two classes, not consistent with nature, Larrey conceives has been the cause of a great deal of harm. Very often the partisans of M. Faure have not dared to resort in the first instance to amputation, the dangers of which they exaggerate; while on other occasions, they have amputated, consecutively, without any success.

Larrey argues that the effects of commotion, instead of increasing, gradually diminish, and disappear after the operation. He will not even admit that the patient's alarm ought to be a reason for postponing the operation; because the patient, just after the accident, will be much less afraid of the risk which he has to encounter, than at the expiration of the first four-and-twenty hours, when he has had time to reflect upon the consequences of the injury, or of amputation; a remark made by the illustrious Paré.

"Experience agreeing with my theory (says Baron Larrey), has proved both to the army and navy surgeons, that the bad symptoms which soon follow such gunshot injuries, as must occasion the loss of a limb, are much more to be dreaded than those of immediate amputation. Out of a vast number of the wounded, who suffered amputation in the course of the first four-and-twenty hours after the memorable naval battle of the 1st of June, 1794, a very few lost their lives. This fact has been attested by several of our colleagues, and especially by M. Fercoc, surgeon of the ship *Le Jemappe.*"

The following is said to be an extract from one of his letters:—

"After the naval engagement of the 1st of June, 1794, a great number of amputations were done immediately after the receipt of the injuries. Sixty of the patients, whose limbs had been thus cut off, were taken to the naval hospital at Brest, and put under the care of M. Duret. With the exception of two, who died of tetanus, all the rest were cured; and there was one who had had both his arms amputated. The surgeon of the *Téméraire*, which ship was captured by the English, was desirous, in compliance with the advice of their medical men, to defer the operation, which many of the wounded stood in need of, till his arrival in port; but he had the mortification to see them all die during the passage," &c.

Larrey next acquaints us, that, when he was sent to the army of Italy, in 1796, he had also the pain of seeing, in the hospitals, great numbers of the wounded fall victims to the confidence, which many of the surgeons of that army placed in the principles of M. Faure. Buonaparte saw that the *ambulance volante* was the only thing that, in the event of fresh hostilities, could prevent such accidents, and in consequence of his orders, Larrey formed the three divisions *d'ambulance*, which are described in his *Mémoires de Chirurgie Militaire*.

Since this period it has always been customary in the French armies, on the day of battle, to make every preparation for performing amputations as speedily as possible. The mere sight of these *ambulances* (always attached to the advanced guard), says M. Larrey, encourages the soldiers, and inspires them with the greatest courage. On this occasion the following anecdote is cited from Ambrose Paré: this famous surgeon having been urgently sent for by the Duke de Guise, besieged in Metz, to attend the wounded of his army, who were in want of assistance, Ambrose Paré was shown to the frightened soldiers at the breach. Upon this they immediately filled the air with shouts of the most lively joy, and cried out: "*Nous ne pouvons plus mourir, s'il arrive que nous soyons blessés, puisque Paré est parmi nous.*" Their courage revived, and their confidence in this skilful surgeon contributed to the preservation of a place, before which a formidable army was destroyed.

Larrey desires us to interrogate the invalids who have lost one or two of their limbs, and nearly all will tell us, that they suffered amputation a few minutes after the accident, or in the first four-and-twenty hours. "If Faure now retains any partisans," says Larrey, "I recommend them to repair to the field of battle, the day after an action: they would then soon be convinced, that, without the prompt performance of amputation, great numbers of soldiers must inevitably lose their lives. In Egypt this truth was particularly manifested."

The following communication upon this point was made to Baron Larrey by M. Masclet, a French surgeon on duty at Alexandria:—

"In the naval hospital of this port, I have seen eleven soldiers, or sailors, who were wounded in the naval action off Aboukir, and who had suffered amputation in the first four-and-twenty hours. In five of these cases the operation had been done on the arm; in two, on the thigh; and, in three others, on the leg. All these men are recovering. In the army hospital there have been only three thigh amputations, which we performed seven or eight days after the battle, and these three patients died a few days after the operation, although the operation was done methodically, and no grave symptoms prevailed at the time of its performance. You see, sir, experience has, in this instance, quite confirmed your principles."

In 1780, during the American war, as we are informed by Larrey, the surgeons of the French followed the maxim then generally adopted in France, that the operation should not be undertaken till after the subsidence of the first symptoms. Almost all the patients thus treated, died after the operation. On the contrary, the Americans, who had the boldness to amputate immediately (or in the first four and twenty hours) upon many of their wounded countrymen, lost only a very few. Yet M. Dubor, at that time surgeon to the Artois dragoons, and from whom Larrey has collected this fact, states, that the situation of the hospital for the French wounded was, on many accounts, the most advantageous. (*Dubor, Thèse Inaugurale, soutenue* 16 *Sept.*, 1803, *à l'Ecole de Strasburg.*)

Admitting that, by a concurrence of fortunate circumstances, which are not always to be calculated upon, some patients escape the danger of the first symptoms, as Larrey remarks, this proves nothing in favour of doing the operation afterwards: it must be seen what nature will do towards the event of the case. If at the end of twenty or thirty days, the prognosis is as bad as it was previously, amputation cannot be avoided. Thus all the sufferings which the patient has endured, have been undergone for nothing, and the operation will now be attended with considerable risk, inasmuch, as the patient is in a dangerously weakened state. If nature revives at all, no doubt the success of the operation becomes more probable; but, in this case, the surgeon, instead of having recourse to amputation, should redouble his efforts to preserve the limb.

Cases demanding Amputation consecutively.

First case. A spreading Mortification.—If the disorder were owing to an internal and general cause, it would be rashness to amputate before nature had put limits to the disease. Larrey describes this species of gangrene, as being distinguished from that kind which is named *traumatic*, by the symptoms which precede and accompany it. These symptoms are similar to those which are observed in nervous and typhoid fevers. Here the operation ought to be deferred, and endeavours made to combat the general causes with regimen and internal medicines.

But when gangrene is *traumatic*, Larrey advises the limb to be immediately cut off above the disorganised part. Several facts in support of this doctrine, are related by this experienced surgeon in his *Mém. sur la Gangrène Traumatique.* (See Mortification.)

In that part of the Dictionary will be found additional observations, in favour of the practice adopted and recommended by Larrey, which is so opposite to that inculcated by Sharp, Pott, and the generality of writers.

In the article Amputation, I have noticed a particular case of gangrene, which has been pointed out by Mr. Guthrie, as demanding the early performance of amputation, and a deviation from the old rule of waiting till the mortification has ceased to spread. (*On Gunshot Wounds of the Extremities*, p. 63. &c.)

Second case. Violent Spasms and Tetanus.—It is one of Larrey's doctrines, though not a well-founded one, that amputation of the limb, performed immediately the first symptoms of tetanus manifest themselves, interrupts all communication between the source of the disorder and the rest of the body. He states that the operation unloads the vessels, and thus puts a stop to the tension of the nerves, and to the contracted state of the muscles. These first effects, he says, are followed by a general collapse, which promotes the excretions, sleep, and the equilibrium of every part of the system. Amputation, however, is entirely renounced in this country, as a remedy for tetanus. In France also Baron Dupuytren condemned the practice. (See *Clin. Chir.* t. ii. p. 599., and t. iv. p. 270.) One of Larrey's patients, with traumatic tetanus, recovered after amputation; and a few cases of success are recorded in periodical works. Yet M. Velpeau, after adverting to them, expresses his little confidence in the practice, and his disinclination to imitate Baron Larrey and M. del Signore. (See *Nouv. Elém. de Méd. Opér.* t. i. p. 279.; and Tetanus.)

Third case. Bad State of the Discharge. — It often happens, that, in gunshot wounds complicated with fractures, notwithstanding the most skilful treatment, the discharge becomes of a bad quality; the fragments of bone lie surrounded with the matter, and have not the least tendency to unite; the patient is attacked with hectic fever, and a colliquative diarrhœa. Under these circumstances, life may sometimes be preserved by amputation.

Fourth case. Bad State of the Stump. — In hospitals, the cure of amputations is sometimes prevented by a fever of a bad character. The stump swells, the integuments become at first retracted, and then everted and diseased a good way upward. The wound changes into a fungous ulcer, the cicatrisation of which is hindered by the deep disorder of the bone, and the ulceration of the soft parts. The extremity of the bone projects. In order to remedy this last evil, it has been proposed to saw off the projecting part of the bone, and, with this, even to amputate all the flesh beyond the level of the skin. Larrey condemns such practice as unnecessary and dangerous, and he recommends giving nature time to bring about exfoliation. (See *Mém. de Chir. Militaire*, t. ii.) Exceptions to this advice, however, are met with.

Gunshot Wounds of the Abdomen,

May be divided into two kinds; some only penetrate the parietes of the belly, without hurting the contained parts; others do mischief also to the viscera: the event is generally very different. In the first, little danger is to be expected, under proper treatment; but, in the second, the success will be extremely uncertain, for in many instances nothing can be done for the patient, and on other occasions a good deal.

It is observed by John Hunter, that such wounds of the abdomen as do not injure parts like the stomach, intestines, bladder, ureters, gall-bladder, large blood-vessels, &c., all which contain particular fluids, will generally end well. But he adds, that there will be a great difference, when the ball has passed with immense velocity, as a slough will be produced; whereas, when the ball has moved with less impetus, there will not be so much sloughing, and the parts will in some degree heal by the first intention. Even when the ball occasions a slough, the wound frequently terminates well, the adhesive inflammation taking place in the peritoneum, all round the wound, so as to exclude the general cavity of the abdomen from taking part in the inflammation. Such is often the favourable event, when the ball, besides entering the abdomen, has wounded parts like the omentum, mesentery, &c., and gone quite through the body. (*Hunter on Inflammation, Gunshot Wounds, &c.* p. 543.)

In gunshot wounds of the belly, an extravasation is apt to take place on the sloughs becoming loose, about eight, ten, twelve, or fourteen days after the accident; but, says Mr. Hunter, although this new symptom is in general very disagreeable, most of the danger is usually over before it can appear.

The stupor, that remarkable consequence of severe injuries, is particularly observed to follow those affecting the cavity of the abdomen. The patient quickly turns yellow, and lies completely motionless, inattentive to every thing around him. (See *Dupuytren, Clin. Chir.* t. ii. p. 543.) This I have often seen exemplified in fatal cases.

When a ball passes through the pelvis, and breaks the bones, this latter circumstance alone constitutes a formidable accident; for, as Dupuytren observes, the bones are deep, covered by a thick mass of soft parts, and surrounded by considerable vessels and nerves. If the organs contained in the pelvis are wounded, the fluids or matters which are within them, are effused, inflammation ensues, and the result is mostly fatal. If large vessels are opened, the hæmorrhage cannot be stopped. If nerves are injured, paralysis of the rectum, bladder, or lower extremities, is the consequence. If the ball lodges in the thick substance of the bones, it is apt to bring on necrosis, periostitis, extensive and deep abscesses, sinuses, and fistulous openings. A wound of the bladder is followed by effusion of urine; one of the rectum, by that of fecal matter; the dangers of which occurrences are great. (See *Dupuytren*, in *Clin. Chir.* t. ii. p. 544.)

In the article Wounds, I have detailed at large the general principles, which should be observed in the treatment of wounds of the belly; consequently it would be superfluous here to go over the whole of this extensive subject. As an excellent practical writer observes, "In their treatment, the violence of symptoms is to be combated more by general means, than by any of the mechanical aids of surgery. The search for extraneous bodies, unless superficially situated, is altogether out of the question, except they can be felt with the probe, as in Ravaton's case (*Chir. d'Armée*, p. 211.), or in other cases of lodgment in the bladder, where they may become the object of secondary operations. Enlargement or contraction of the original wound, as the case may require, for returning the protruded intestine, securing the intestine itself, and promoting the adhesion of the parts, are all that the surgeon has to do in the way of operation; and, even in this, the less he interferes the better. Nature makes wonderful exertions to relieve every injury inflicted upon her, and they are often surprisingly successful, if not injudiciously interfered with. In a penetrating wound of the abdomen, whether by gun-shot, or by a cutting instrument, if no protrusion of intestine take place (and this, it must be observed, in musket or pistol wounds rarely occurs), the lancet, with its powerful concomitants, abstinence and rest, particularly in the supine posture, are our chief dependence. Great pain and tension, which usually accompany these wounds, must be relieved by leeches to the abdomen (if they can be procured), by topical applications of fomentations, and the warm bath; and, if any internal medicine is given, as a purgative, it must, for obvious reasons, be of the mildest nature. The removal of the ingesta, as a source of irritation, is best effected, by frequently repeated oleaginous clysters" (see *Hennen's Principles of Military Surgery*, p. 431. ed. 2.); and, with respect to dressings, as the same author has observed, concerning cases in which a ball has passed directly through the abdomen, the mildest application should be employed, and no plugging with tents, nor introduction of medicated dressings, thought of. (P. 406.) In this publication may be found cases, in which musket-balls were passed by stool (p. 404.); in which an artificial anus was formed (p. 407, &c.); or the kidneys, liver (p. 430—432.), diaphragm (p. 437.), and other viscera, injured.

The following case, exhibiting the possibility of recovery, though the small intestine be completely severed with a ball, is interesting, particularly as cases of this kind have been regarded as positively fatal. The success was also obtained, notwithstanding the treatment appears to have been rather too officious, especially in regard to four incisions made in the end of the bowel, when one would have removed the constriction spoken of.

At the assault of Cairo, 1799, M. N. was shot in the abdomen with a ball, which divided the muscular parietes of this cavity on the right side, and a portion of the ileum. Larrey being upon the field of battle, gave him the first assistance. The two ends of the intestine protruded in a separated and inflated state. The upper end was everted, in such a way, that its contracted edge, like the prepuce in a case of paraphymosis, strangulated the intestinal tube. The course of the feces was thus obstructed, and the contents of the bowel accumulated above the constriction.

Although the patient's recovery was nearly hopeless, both from the nature of the wound, and from the debility and cholera morbus which had already seized him in the short period that he remained without succour in one of the intrenchments, Larrey was desirous of trying what could be done for so singular a case. He first made four small cuts through the constricted part of the intestine, with a pair of curved scissors, and put the bowel into its ordinary state. He passed a ligature through the piece of the mesentery corresponding to the two extremities of the bowel. These he reduced as far as the margin of the opening, which he had taken care to dilate; and the dressings having been applied, he awaited events. The first days were attended with alarming symptoms, which, however, afterwards subsided. Those which depended upon the loss of the alimentary matter, successively abated; and, after two months, the ends of the ileum were opposite each other, and disposed to become connected together. Larrey seconded the efforts of nature, and dressed the patient with a tampon, or sort of tent, that was occasionally employed for two months. The patient was then discharged from the hospital quite cured.

In several instances, says Larrey, the sigmoid flexure of the colon was injured, and yet the wounds were cured without any fecal fistulæ. At the siege of Acre, three examples occurred; and, at that of Cairo, two. Larrey dilated the entrance and exit of the ball. Clysters of the decoction of linseed, and emollient beverages, were frequently exhibited; and the patients were kept on low diet, and in the most quiet state.

Sword-wounds, and those made with the bayonet, or lance, may injure some part of the bladder, or even pass through both sides of this organ. In the latter case, the injury is usually fatal, as the urine escapes from the inner wound into the abdomen, and immediately excites mortal inflammation. Baron Larrey dressed on the field of battle several soldiers, whose bladders were thus completely transfixed, and who all perished of inflammation and gangrene, within the first forty-eight hours. However, he observes, that if the weapon enter the bladder at that part of its fundus which is not covered by the peritoneum, the case is curable, unless complicated with too much internal hæmorrhage.

The surest criterion of these cases is the escape of the urine from the external wound; and its discharge may either be momentary, occasional, or continual; differences to be accounted for by the situation of the wound, and the changes which happen in the bladder. When the bladder is full, and its upper part is pierced, the urine will issue only just at the moment of the accident, and, as soon as it is discharged, the edges of the wound will come together, and permanently close, especially, if the urine can pass freely through the natural channel. But when this favourable condition is absent, the bladder becomes enormously distended again, the wound is opened anew, and the urine discharged once more from the external opening. The same things might happen, if one were to withdraw too soon the elastic gum catheter, which has been introduced,: and by introducing the instrument again, the urine might be diverted from the wound, and its natural course re-established. Lastly, Larrey observes, that, when the wound is situated at one of the lowest points of the bladder, the discharge of urine may be incessant, and be of more or less duration.

When the track of these punctured wounds is extensive, and not direct, abscesses form at different points where the urine passes. These abscesses, Larrey directs to be immediately opened, and their recurrence prevented by the introduction of an elastic gum catheter through the urethra; one of the chief means of relief in all wounds of the bladder. Together with this treatment, he recommends the warm bath, the application of camphorated oily liniments to the belly, antispasmodic cooling medicines, frequent clysters, and sometimes cupping in the vicinity of the wound, or bleeding. (See *Mém. de Chir. Mil.* t. iv. p. 286, 287.) On the two last means of relief, it would have been better if Larrey had laid more stress; for, next to the catheter, they are unquestionably the most essential.

Baron Larrey informs us, that the gunshot wounds of the bladder, which occurred in Egypt, had for the most part a favourable termination. The most remarkable case was that of F. Chaumette, a light horseman, who was wounded at the battle of Tabor. The ball passed across the hypogastrium, about one finger-breadth above the pubes, to the point of the left buttock, which corresponds to the ischiatic notch. The direction of the wound, and the issue of feces and urine from the two orifices, left no doubt that the bladder and rectum were injured. M. Milioz, who directed the surgical affairs of the division of the army under Kleber, diligently pursued the same kind of treatment which he had seen Larrey adopt at the siege of Acre. During the suppurative stage, the patient was affected with fever; and, after the sloughs were detached, the discharge was very copious. A catheter that was passed into the bladder, prevented an extravasation of the urine, and, at the same time, promoted the union of the wound of that viscus. This was healed the first, and the patient, upon his return to Cairo, was quite cured.

Larrey has recorded several other interesting cases of wounds, either of the bladder alone, or of it and the rectum together, to which I must content myself with referring. (See *Mém. de Chir. Militaire*, t. ii. p. 160. 165.; t. iii. p. 340. &c.; t. iv. p. 296. &c.)

A ball may go through both sides of the bladder, and then either perforate the neighbouring parts, and escape externally, or bury itself deeply in the flesh. When it has gone quite through the bladder, and afterwards passed out of the body again, urine, blended with blood, immediately issues from one or both apertures, according to their situation. The flow of urine through the urethra is either lessened, or completely suppressed; but, through this passage, the patient generally voids more or less blood. Acute and incessant pain is felt in the course of the wound, together with a frequent painful desire to make water, nausea, sometimes actual vomiting, and extreme anxiety, and restlessness. Either in its passage inwards, or its course outwards, the ball may have injured, or perforated the rectum; in which case, the urine passes into this bowel, and, mixing with the feces, is discharged from the anus.

When a part of the bladder, towards the cavity of the abdomen, is injured, as, for instance, its posterior surface, which is covered by the peritoneum, the urine is generally extravasated within the belly, and inflammation of the preceding membrane is the immediate consequence. This inflammation spreads with rapidity, and attacks all the viscera, producing vast distension of the abdomen, fever, coma, and other bad symptoms, soon terminating in gangrene and death. (*Larrey, Mém. de Chir. Mil.* t. iv. p. 292, 293.)

During the first four-and-twenty hours, very little urine escapes from gunshot wounds of the bladder, in consequence of the swelling, which almost instantly affects the lips of the wound. When the bladder is full, this fluid is discharged, only at the moment of the accident, and mostly only from the wound by which the ball has made its exit. An extravasation is prevented by the thick slough which fills all the track of the injury, and it is not till the deadened parts become loose, that any effusion can happen. Hence, it is of the highest importance to introduce an elastic gum catheter into the bladder, where it should be kept, and the instrument should be large enough to fill exactly the urethra; for, according to Baron Larrey's observations, if, at the period when the sloughs are detached, the urine has not a ready passage outward, it passes through the wound, and is extravasated the more readily, inasmuch as the separation of the sloughs has occasioned many openings, by which the fluid may insinuate itself into the cellular membrane. Hence, gangrenous mischief and death.

On two points, my own experience would not lead me to join in the sentiments of Larrey: first, in opposition to his statement, I am sure that there is risk of extravasation of urine earlier than the period which he specifies, having known this accident commence as it were within a few hours after the receipt of the wound; and therefore, I should not depend upon the sloughs being always at first a complete barrier to extravasation of urine (indeed, their formation throughout the whole track of a gunshot wound is by no means a regular occurrence), but invariably pass a catheter as soon as possible, for the more certain prevention of this dangerous consequence. Secondly, the period of the separation of sloughs may, indeed, often be contemporary with the first appearance, or symptoms of extravasation, particularly in cases where the employment of the catheter is for some time deferred, as in Baron Larrey's practice, because then a partial extravasation of the urine, soon after the injury, and previous to the introduction of the catheter, will cause rapid sloughing, and actually prevent the adhesive inflammation from closing up the cavities of the cellular membrane in time to prevent a fatal extension of that irritating fluid amongst the surrounding parts. Were it not for the partial early effusion of urine, no doubt, the adhesive inflammation would, in these cases, soon have the same effect, in obviating the danger of urinary extravasation, which it has after lithotomy, or paracentesis of the bladder. (See Bladder.)

It is the practice of Baron Larrey to dilate the wounds, in order to facilitate the escape of the urine, which might otherwise lodge in the track of the ball; and perhaps, here the method may frequently be right, though I should conceive its propriety must usually depend upon whether the urine has a tendency to continue to flow out through the wounds, or not, and upon the presence of obstruction or not. And, in confirmation of this opinion, I may cite Dr. Hennen's declaration, that, in these cases, he has very rarely found it necessary to enlarge the wound, when the catheter and proper dressings have been employed. (*On Military Surgery*, p. 421. ed. 2.) And, as soon as possible, a large elastic gum catheter should be introduced, and left in the urethra taking care to withdraw it, and pass in a clean one every two or three days, so that no incrustations may occur. Sometimes, however, the passage of a catheter is very difficult, as is the case, when there are splinters of bone in the urethra, or the parts about the neck of the bladder are inflamed. (*Mém. de Chir. Militaire*, t. iv. p. 294.) Emollient clysters, and acidulated demulcent drinks, are to be prescribed, and the patient is to be kept upon a very low regimen, and in the most quiet state. The dressings are to be light and simple, and cleanliness observed. (*Op.* cit. t. ii. p. 165—170.) Instead of camphorated embrocations to the abdomen, another means commended by Larrey, it appears to me, that this author's directions would have been more complete and judicious, had he advised in these cases bleeding, both topical and general.

From the injury of arterial ramifications, or varicose vessels, blood is sometimes extravasated within the wounded bladder, and causes deep-seated irritation. According to Baron Larrey, the case is indicated by the symptoms of retention of urine, and those of inflammation, with a small pulse, pallor of the countenance, and dryness of the wounds. (T. iv. p. 295.) A more decided criterion, I should think, would be the partial escape of urine mixed with blood, a symptom, which could deceive only where the urethra itself had been injured. Larrey states, that blood, extravasated in the bladder, rarely coagulates, because blended with urine, and hence, he advises its discharge to be facilitated by means of a catheter, and tepid, emollient, anodyne injections. (T. iv. p. 295.)

Sometimes, balls carry before them into the bladder, fragments of bone, small coins, pieces of buttons, &c.; or bits of bullets break off, and lodge in that viscus. When these extraneous bodies are not above a certain size, they are frequently voided through the urethra (see *Cases in Hennen's work*, p. 419. 422. 424. &c. ed. 2.), and their evacuation may be materially facilitated by the introduction of an elastic gum catheter, the size of which is to be increased gradually, until the largest can be passed, when the foreign substances will readily enter the tube, or pass out through the dilated urethra. In this way, Baron Larrey has saved gravel patients from a vast deal of suffering. (*Mém. de Chir. Mil.* t. iv. p. 302.) In such cases, the urethral forceps, made by Mr. Weiss, might often be used with advantage. (See *Lithotomy.*) When the ball is too large to be taken out in this manner, the lateral operation is to be performed, and it ought to be done before the bladder falls into an ulcerated, or gangrenous state, from the pressure and irritation of the foreign body. However, as wounds of this organ frequently give rise to dangerous inflammation, Larrey recommends this operation to be done either before its attack, or after its subsidence. (Vol. cit. p. 309.) In fact, almost all the operations of this kind on record have been done some considerable time after the receipt of the wound, and to this practice my own judgment would lead me to give a general preference. In one case, however, Larrey operated on the fourth day after the receipt of the wound, and with success.

After the battle of Waterloo, I was not a little surprised to find, in the hospital established in the St. Elizabeth Barracks, at Brussels, a considerable number of cases, in which either the intestines, the stomach, the omentum, or the bladder protruded. I think, we had in the division under Mr. Collier and myself, not less than three protrusions of the bladder. An order, which I received to join the army in the field on the 27th of June, deprived me of the opportunity of witnessing the progress and termination of these interesting cases. However, many had ended fatally before my departure from Brussels.

Cannon-balls sometimes rupture, or crush the viscera, without occasioning any wound of the skin; such cases I have already noticed in considering the erroneous doctrine of *wind contusions.* Whoever has served in a campaign must have had opportunities of seeing such accidents. They are recorded by every writer. Dupuytren gives the particulars of one, in which all the soft parts of the lumbar region, together with the left kidney, were crushed to atoms; the lumbar nerves lacerated; the transverse processes of the lumbar vertebræ, and the last ribs comminuted; and the cavity of the abdomen, and injured side of the chest, filled with blood. The skin was the only texture that had resisted the ball. (See *Clin. Chir.* t. ii. p. 241.)

Gunshot Wounds of the Thorax.

Wounds of the lungs, abstracted from other mischief are now well known not to be always fatal. Balls have been found in the substance of the lungs after having lodged there twenty years, during all which time the patients were healthy, and free from symptoms indicative of the case. (*Percy, Manuel, &c.* p. 25.) Mr. Hunter had some reason to believe, that wounds of the lungs made with balls, were generally less dangerous than such as were made with sharp-pointed instruments; for he had seen several patients recover after they had been shot through the lungs, while other persons died of very small wounds of those organs, done with swords and bayonets. Perhaps, one cause of this fact may be owing to the circumstance of gunshot wounds generally bleeding less than other wounds, so that there is not so much danger of blood being effused in the cavity of the chest, or the cells of the lungs. The indisposition of the orifice of a gunshot wound to heal up too soon, is also another circumstance that must lessen the hazard, as whatever matter happens to be extravasated has thereby an opportunity of escaping.

But, from what has been stated, it must not be inferred that gunshot wounds of the lungs are not accompanied with a serious degree of danger. Frequently the patient expires instantly, being suffocated in consequence of profuse hæmorrhage from those organs; for, though it be true, that gunshot wounds generally do not bleed much, when the injured vessels are under a certain size, yet, the contrary is the case, when the wounded vessels are like those situated towards the root of the lungs. Gunshot wounds of the chest often prove fatal by the inflammation excited within this cavity; and occasionally when the lung is wounded, they are followed by an extensive and even fatal inflation of the cellular tissue of the whole body. (See Emphysema.)

Appearances sometimes create a belief, that a ball has passed completely through the chest and lungs, when the fact is otherwise. "Thus (as Dr. Hennen observes), I have traced a ball by dissection, passing into the cavity of the thorax, making the circuit of the lungs, penetrating nearly opposite the point of entrance, and giving the appearance of the man having been shot fairly across, while bloody sputa seemed to prove the fact, and, in reality, rendered the same measures to a certain extent, as necessary as if the case had been what was suspected. The bloody sputa, however, were only secondary, and neither so active and alarming as those which pour out at once from the lungs when wounded." (*Military Surgery*, p. 368. ed. 2.) A second cause of deception is the frequent long course of a ball, round the chest under the skin and muscles, previously to its exit, whereby an appearance is presented, as if the patient had been shot through the thorax. And, another source of deception, as to the actual penetration of balls, is "where they strike against a handkerchief, linen, cloth, &c. and are drawn out unperceived in their folds, a peculiarity which has not escaped M. Larrey, who gives an interesting notice of it in the *Bulletins de la Faculté de Méd.* Paris, 1815, No. 2. I have also given an instance in the preceding pages." (*Hennen*, loco cit.) In these cases, the absence of bloody expectoration directly after the injury, the undisturbed state of respiration, and the greater freedom from oppression, anxiety, syncope, and other bad symptoms, than in cases where the lungs are hurt, form grounds for a correct opinion on the true nature of the accident.

It cannot be supposed that adhesions always take place round the opening of a gunshot wound in the chest, because the lung sometimes collapses, and becomes considerably distant from the pleura, especially when the communication established between the atmospheric air and the cavity of the thorax is free and direct. However, as adhesions are extremely common between the outer surface of the lung, and the inner surface of the pleura costalis, they must, in many instances, exist before the receipt of a wound, and, of course, prevent the usual collapse of the lung.

As the general symptoms and treatment of wounds of the chest are detailed in the article Wounds, I shall not here detain the reader long upon the subject. When a patient has been shot in the chest, the most important indication is to prevent and subdue inflammation of the lungs and pleura. In few other cases can repeated and large bleedings be so advantageously practised. Here, there will not be so much danger of an extravasation of blood as in stabs; and, even if an effusion of that fluid were to happen within the cavity of the pleura, the opening would generally be sufficient for its escape, and it would not be so frequently found necessary to dilate the wound, or make a new opening, as when the injury has been inflicted with a sharp-pointed weapon.

In this last kind of case, when attended in the beginning with bleeding, Baron Larrey particularly insists upon the advantage of immediately bringing the edges of the wound together with adhesive plaster, instead of leaving it open as advised by the generality of writers; and he endeavours to prove, that this immediate closure of the wound has great effect in stopping the hæmorrhage from the pulmonary vessels. Supposing an extravasation of blood in the chest were to follow, he argues, that it would be better to let it out afterwards by a suitable incision, than to suffer the patient to perish of hæmorrhage at once by not closing the wound. (*Mém. de Chir. Mil.* t. iv. p. 151. &c.) Dr. Hennen is in favour of the same practice. (*On Military Surgery*, p. 373. ed. 2.) In a penetrating gunshot wound of the chest, after taking away from thirty to forty ounces of blood, the surgeon should extract all extraneous substances, and splinters of bone within reach, and even dilate the external wound for this purpose, if necessary. Light unirritating dressings are then to be applied. The patient may now be (comparatively speaking) easy, until the spitting of blood, and danger of suffocation, from inward hæmorrhage, come on again, when the lancet must be again employed; "and, if by this management, repeated as often as circumstances demand, the patient survives the first twelve hours, hopes may begin to be entertained of his recovering from the immediate effects of hæmorrhage," and until this danger is over, as Dr. Hennen truly observes, the lancet is the only thing which can save life. Afterwards, when the paroxysms of pain, the sense of suffocation, and the return of hemorrhage, have become more moderate, digitalis may be prescribed with the most beneficial effect; and, if the cough be very troublesome, no medicine is more useful than the spermaceti mixture with opium. With this treatment must be combined the exhibition of saline purgatives, mild laxative clysters, and a strictly low diet, the patient being allowed only slops. (See *Hennen's Military Surgery*, p. 373. ed. 2.)

When matter forms in the thorax, in consequence of gunshot wounds, the opening will generally suffice for its escape; but, should the collection of pus be confined, and occasion dangerous symptoms, the external wound must either be enlarged, or a new incision practised, as circumstances may indicate. The mode of making an opening in the chest is considered in the article Paracentesis.

When a ball lodges, without falling into the chest, it may lie either in the substance of the parietes of this cavity between the muscles, or in one of the intercostal spaces, and continue there a very long time without causing much inconvenience, or making its way outward. But, when it is lodged in the thoracic cavity itself, it descends by its weight, and sometimes excites considerable irritation, suppuration, sinuses, and hectic symptoms; in this case, if its situation can be ascertained, Baron Larrey recommends an attempt to extract it. In an early stage of the case, he says, that the intercostal space will often be wide enough to let the ball pass through it; but that, at a later period, this space becomes too narrow, and it will be necessary to cut away a portion of the upper edge of the rib with a lenticular knife, which is to be preferred to a trephine, or saw. This advice is supported by some interesting cases. (See *Mém. de. Chir. Mil.* t. iv. p. 253.) Frequently, the ball fractures the rib, and, with the aid of dilatation, sufficient room for its extraction may be made: but the possibility and propriety of removing it through the original opening will, of course, depend upon the situation of the foreign body, and the urgency of the symptoms. A case is recorded, in which a ball weighing three ounces and a half, was thus removed. (*Med. and Surg. Journ.* vol. iii. p. 353.)

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de ces Articulations, par *M. Boucher*, in Mém. de l'Acad. de Chirurgie, t. v. p. 279, éd. in 12mo. Obs. sur des Plaies d'Armes à feu, compliquées sur tout de Fracas des Os, par *M. Boucher*, in opere cit. t. vi. p. 109, &c. éd. in 12mo. Obs. sur les Plaies d'Armes à feu: 1. Sur un Coup de Fusil, avec Fracas des deux Machoires; par *M. Cannac:* 2. Sur une Plaie d'Arme à feu traversant la Poitrine d'un còté à l'autre; par *M. Gerard:* 3. Sur une Plaie d'Arme à feu, pénétrante depuis la Partie antérieure du Pubis jusqu'à l'Os Sacrum; par *M. Andouillé:* 4. Sur une Jambe écrasée par un Obus, ou petite Bombe, par *M. Cannac:* 5. Sur une Plaie à la Partie inférieure et interne de la Jambe, faite par un Eclat de Grenade, sans Fracas d'Os; par *M. Cannac:* 6. Précis de plusieurs Observations sur les Plaies d'Armes à feu en différentes Parties, par *M. Bordenave:*—all these papers are inserted in Mém. de l'Acad. de Chir. t. vi. in 12mo.; and in t. xi. of the same edition are inserted Mém. sur le Traitement des Plaies d'Armes à feu, par *M. de la Martinière*, et Mémoires sur quelques Particularités concernant les Plaies faites par Armes à feu, par *M Vacher*. *M. Faure*'s Memoirs relative to Amputation in Cases of Gunshot Wounds, may be seen in t. viii. of the Recueil des Pièces qui ont concouru pour le Prix de l'Acad. de Chirurgie, éd. in 12mo. *John Hunter*'s Treatise on the Blood, Inflammation, and Gunshot Wounds, 1794. *Richter*, Anfangsgründe der Wundarzneykunst, b. i. *Schmucker*, Vermischte Chir. Schriften, 3 vols. 8vo. Berlin, 1776, 1782.: Chirurgische Wahrnehmungen. Berlin, 2 vols. 8vo. 1744, 1789: works of high value. Discourses on the Nature and Cure of Wounds, by *John Bell*, p. 169. &c. ed. 3. *Richerand*, Nosographie Chir. t. i. éd. 4. *Chevalier*'s Treatise on Gunshot Wounds, ed. 3. *Leveillé*, Nouvelle Doctr. Chir. t. i. chap. viii. p. 436. &c *Larrey*, Mém. de Chirurgie Militaire, 4 tomes, 8vo. Paris, 1812, 1817; one of the most instructive books for army surgeons ever published. Mém. par *M. De Conte*, Prix de l'Acad. t. viii. Examen des plusieurs Parties de la Chirurgie, par *M. Bagieu*, à Paris, 1756. *Bilguer*, Dissert. de Membrorum Amputatione rarissime administrandâ, aut quasi abrogandâ; Halæ, 1761: this work is celebrated as having attracted most deservedly the criticisms of Pott, La Martinière, Morand, &c. *Morand*, Opuscules de Chirurgie, 1768. *Van Gesscher*, Abhandlung von der Nothwendigkeit der Amputation; Freyberg, 1775. *M. G. Daignan*, Réflexions Importantes sur le Service des Hopitaux Militaires, 8vo. Par. 1785. *Mursinna*, Neue Medicinisch-Chirurgische Beobachtungen, zweiter theil, s. 138. Berlin, 1796. *Wedekind*'s Nachrichten über das Französische, Kriegspitalwesen, erster b. Leipzig, 1797. *Baron Percy*, Manuel du Chirurgien d'Armée, 8vo. Paris, 1792. *Paroisse*, Opuscules de Chir. 8vo. Paris, 1806. *Graefe*, Normen für die Ablösung Grösserer Gliedmassen, 4to. Berlin, 1812. *Assalini*, Manuale di Chirurgia, 8vo. Milano, 1812. *Guthrie*, on Gunshot Wounds of the Extremities. Lond. 1815; or the 2d ed. 8vo. Lond. 1820; a work detailing the practice of our military surgeons during the late war in Spain, and replete with valuable information. *Thomson*'s Report of Observations made in the Military Hospitals in Belgium. Edinb. 1816. *A. C. Hutchison*'s Practical Obs. in Surgery, 1816; and ed. 2d. 1826. Also, Further Obs. on the Period for amputating in Gunshot Wounds, 8vo. Lond. 1817. *Millingen*'s Manuel, 8vo. Lond. 1819. *J. Hennen*'s Principles of Military Surgery, 2d. edit. 8vo. Edinb. 1820; a publication which I cannot too strongly recommend, not only to army and navy surgeons, but to practitioners in general. *James Mann*, Medical Sketches of the Campaigns of 1812, 13, 14. &c. 8vo. Dedham, 1816. *M. Le Baron Dupuytren*, Leçons Orales de Clin. Chir. t. ii. art. 7, and t. iv. art. 7. and 14. 8vo. Paris, 1832-34. *Hippolyte Larrey*, Hist. Chir du Siége de la Citadelle d'Anvers, 8vo. Paris, 1833.

GUTTA SERENA. A term said to have been first applied by Actuarius to amaurosis, or the species of blindness arising from a morbid state of the retina, or optic nerve. When the word is now employed, it usually denotes the complete form of amaurosis, or that in which the patient is entirely deprived of the power of discerning objects, or even the difference between light and darkness. (See Amaurosis)

HÆMATOCELE. (From αἶμα, blood, and κήλη, tumour.) A swelling of the scrotum, proceeding from, or caused by, blood.

The term has sometimes been applied to every kind of extravasation of blood about the scrotum and spermatic chord; but, at the present day, it is usually restricted by British surgeons to a collection of blood in the cavity of the tunica vaginalis. Extravasation of blood in the cellular tissue of the scrotum and spermatic chord, or within the structure of the testicle itself, Pott, however, arranges with hæmatocele. This last swelling is generally pyriform, like hydrocele; but is distinguishable from it, by its greater weight and firmness, its want of transparency, its obscure fluctuation, and its cause, which is usually a blow upon the scrotum, or an accidental puncture of some vessels of the testicle, or tunica vaginalis, in tapping a hydrocele. When the latter membrane has been long, or much distended by the serous fluid of hydrocele, it becomes thickened, and its vessels, especially those of its inner surface, enlarged, and even varicose. If one of these lies in the way of the instrument, with which the hydrocele is tapped, it is of course wounded, and then the fluid, which is discharged, is deeply tinged with blood. Should the bleeding continue, after the evacuation of the hydrocele, the blood will accumulate in the cavity of the tunica vaginalis, and, in the course of two or three hours, the scrotum will again be considerably swollen. In one or two examples, I have known hæmatocele follow the tapping of a hydrocele with a lancet, or other sharp-edged instrument. Sir Astley Cooper has noticed this risk, as attending the plan of tapping a hydrocele with a lancet. (*On the Structure and Dis. of the Testis*, p. 212.) A gentleman in the Fleet prison, took it into his head to tap his hydrocele with a kind of long spring-lancet of his own invention: the operation was followed by the rapid formation of a very large hæmatocele.

Sometimes one of the enlarged veins of the tunica vaginalis bursts of itself, after the fluid of a hydrocele has been discharged, and hæmatocele then comes on, as it were, spontaneously. According to Sir Benjamin Brodie, hæmatocele may arise from a diseased condition of the arteries. "This is analagous to that which occurs in the brain, under the form of sanguineous apoplexy. There is a natural change, which takes place in the arteries of old persons; they become ossified in patches, and ulcerate; and I have known this to lay the foundation of hæmatocele." (See *Lond. Med. Gaz.* vol. 1831-32, p. 927.)

As Sir Astley Cooper observes, hæmatocele is often connected with hydrocele, and a consequence of it. The latter disease frequently becomes complicated with hydrocele from an accidental blow on the tumour, occasioning a rent in the tunica vaginalis. In one case, operated upon by Sir Astley Cooper, this membrane had been ruptured to the extent of between one and two inches. The same distinguished surgeon records the case of a gentleman, in whom hæmatocele arose, not from a blow, but from excessive bodily exertion. (*On the Structure, &c. of the Testis*, p. 213—215.)

However, of all the causes of hæmatocele, a blow on the scrotum is the most frequent, and especially a blow from the pummel of the saddle in riding. I have known the disease produced, however, by external violence of different kinds; as by a fall against a piece of timber, by which the scrotum was violently struck. After such accidents, the scrotum will suddenly swell to double or treble its natural size. Every swelling, so produced in the scrotum by effused blood, is not invariably a collection of this fluid in the tunica vaginalis; for sometimes the extravasation is in the loose cellular tissue external to this membrane. Hæmatocele is to be distinguished from the latter case, partly by the oblong or pyriform shape of the tumour, its obscure fluctuation, its freedom from the common appearances of ecchymosis, and its presenting itself more on one side of the scrotum, than the other; while an extravasation of blood in the cellular tissue generally is more diffused, produces a dark blue discolouration of the part, and conceals more or less both testes.

When hæmatocele occurs in combination with hydrocele, the blood is mixed with the serous fluid contained in the tunica vaginalis, and partially dissolved in it: if the quantity of blood be small, the solution is complete; but, in the opposite case, coagula are formed, which remain undissolved. (*Sir B. Brodie, ib.*)

In the dissection of some hæmatoceles, the tunica vaginalis is found excessively thickened; and the blood in it, whether coagulated or fluid, is of the colour of coffee. Sir Astley Cooper refers to a preparation at St. Thomas's Hospital, exemplifying the serious mistake of removing the testicle, while the true disease was merely hæmatocele. The tunica vaginalis was excessively thickened, and filled with coagulated blood of a brownish red colour. (*Op.* cit. p. 215.)

A negro died in St. George's Hospital, who had an enlargement of one testicle; but as it had occasioned little or no inconvenience, the surgeon had not been consulted. Sir Benjamin Brodie examined the part after the patient's death, and found a very large quantity of grumous blood in the tunica vaginalis, and at the back part a soft pulpy mass was seen, not at all resembling the testicle in structure, and only recognisable as such, by its connexion with the epididymis and vas deferens. Sir Benjamin Brodie conceives, that the changed state of the testicle had been occasioned by the pressure of a large quantity of blood. (See *Lond. Med. Gaz.* 1831-1832, p. 927.)

Hæmatocele is sometimes unaccompanied by pain: this is the case, when the quantity of blood is small, and no inflammation present. Under other circumstances, the disease may be attended with excessive pain, and bring on abscesses, gangrene, and dangerous degrees of constitutional disturbance. This was exemplified in the person, whom I have mentioned as having produced hæmatocele by plunging a large lancet into his own hydrocele, for the purpose of curing it himself. In this instance, which I visited with Mr. Bransby Cooper, if a free and prompt incision had not been made to discharge the matter and putrid blood, the patient would soon have lost his life by the violence of the constitutional disturbance. Sir Benjamin Brodie mentions a painter, who was in the habit of drinking to excess, and who, while climbing a ladder, was seized with pain in the testicle, and an enormous hæmatocele formed. In this patient, the symptoms at first were more nearly allied to mania, then delirium.

If hæmatocele be occasioned by a blow, and not accompanied by hydrocele, and the quantity of blood in the tunica vaginalis be moderate, the treatment should consist in keeping the patient in the recumbent position, applying leeches, administering purgative medicines, and covering the tumour with a cold lotion, which will have the effect of checking any further internal bleeding. These means will prevent inflammation, and, after a time, the blood will probably be absorbed. Were the quantity of blood considerable, its pressure might cause an absorption of the testicle (Sir B. Brodie), or, at all events, it would be likely to excite inflammation, and have little or no chance of being dispersed: in such a case, therefore, the best practitioners agree, respecting the propriety of laying open the tunica vaginalis, and taking out the blood.

If hæmatocele be combined with hydrocele, and free from much inflammation, Sir Astley Cooper recommends making an incision into the tunica vaginalis, dicharging its contents, and, without introducing any lint into the cavity, leaving the cure to be completed by the process of inflammation. (*On the Structure, &c. of the Testis*, p. 216.)

If, on drawing off a hydrocele, the contents are tinged with blood, Sir Benjamin Brodie allows the fluid to collect again, and repeats the tappings at intervals, until no blood is mixed with it. The injection may then be used with success. Should the quantity of blood be large, he regards the expectation of its being removed by absorption as hopeless, and, therefore, punctures the tunica vaginalis with a lancet, introduces a director into the opening, and then enlarges it with a scalpel. (*Ib.*)

Whoever has read the observations of Pott on this subject will know, that the operation of laying open the tunica vaginalis, for the cure of hæmatocele, is sometimes followed by a severe attack of symptomatic fever, delirium, and even death. In unfavourable constitutions, the symptoms will generally prove serious, whatever be the mode adopted of dressing the wound, or the internal treatment. But now that the plan of introducing lint and other extraneous substances into the exposed cavity is abandoned, bad cases are far less frequent than formerly. The violence of the symptoms will generally depend upon the degree of inflammation in the parts, and the kind of constitution in which it occurs. If hæmatocele excite inflammation, the clots of blood putrefy, and a gangrenous suppuration follows, attended with an accumulation of sulphuretted hydrogen in the part, and most urgent danger. Here a free opening must be made without delay, the scrotum poulticed or covered with cold lotions, and the patient kept under the influence of the muriate or acetate of morphine.

Mr. Pott, in his account of hæmatocele, comprehends one species, which he describes as an extravasation of blood within the tumica albuginea.

I confess that no good reason appears for arranging cases of this kind with hæmatocele; for, what are they but diseased testicles, which have been punctured, either on account of their seeming to contain a fluid, or really having within them cysts filled with a chocolate-coloured or other fluid, as I have seen in hundreds of instances of sarcocele? and, whatever blood is discharged, is not extravasated in the substance of the testis previously to the puncture, but issues as a necessary consequence of that proceeding.

Another species of hæmatocele, noticed by Pott, "arises from a bursting of a branch of the spermatic vein, between the groin and scrotum, within the sheath of the chord. This, which is generally produced by great or sudden exertions of strength, feats of agility, &c., may happen to persons in the best health.

I cannot conceive, that in any case of a mere rupture of one of the spermatic veins, it can ever be justifiable to tie the whole spermatic chord, and then perform castration, though Pott advises this plan, if the bleeding branch cannot be tied singly. Discutient applications, and an occasional purge, will almost always disperse the swelling; and if not, opening it, and taking out the blood, applying cold, or, if necessary, filling the cavity with lint, and using compression, would be, according to my humble judgment, the most judicious treatment.

With regard to the extravasation of blood in the loose cellular tissue of the scrotum, from blows on the part, and sometimes from lithotomy, castration, &c., I have seen it followed by suppuration and sloughing; but, in general, the effused blood is gradually absorbed, with the aid of discutient applications, leeches, fomentations, poultices, and saline purges. A surgeon should generally be reluctant to lay open the tumour, as, in many instances, sloughing and severe symptoms have been the result.

Celsus and *Paulus Ægineta* are the best of the old writers on hæmatocele. For modern information, consult *Pott*'s Chir. Works, vol. ii. *B. Bell*, on Hydrocele. *Flajani*, Collezione d'Osservazioni, &c. t. ii. *Richter*, Anfangsgr. der Wundarzn. b. vi. *Osiander*, in Arnemann's Magazin für die Wundarzn. b. i. p. 355.: the patient died after an opening had been made in the swelling. *Follet*, in Journ. de Méd. continué, vol. xiii. p. 422.: a case from contusion, cured by an incision. *Harris*, in Mem. of Lond. Med. Society, vol. v. *Sir Benjamin Brodie*, in Lond. Med. Gaz. for 1831-32, p. 926. *Sir Astley Cooper*, in Obs. on the Structure and Dis. of the Testicles, p. 209. 4to. Lond. 1830.

HARE-LIP. (*Labia Leporina.*) A fissure, or perpendicular division, of one or both lips. The term has arisen from the fancied resemblance of the part to the upper lip of a hare. Occasionally the fissure is more or less oblique: it may be directly below the septum of the nose, or correspond to one of the nostrils. The two portions of the lip are generally moveable, and not adherent to the alveolary process; in some cases, they are closely attached to it.

Children are frequently born with this kind of malformation, which is called a *natural* hare-lip, while that which is produced by a wound is named *accidental*. Sometimes the portions of the lip, which ought to be united, have a considerable interspace between them, while in other instances they are not much apart. The cleft is occasionally *double*, a little lobe, or small portion of the lip, being situated between the two fissures; this is termed a *double hare-lip*.

The fissure mostly affects only the lip itself, and usually the upper one. In many cases, however, it extends along the bones and soft parts forming the palate, even as far as the uvula; and sometimes those bones are entirely wanting. In a few instances, the jaw not only is imperfectly ossified in front, so that a cleft presents itself there, but one side of it projects forward, and is at the same time inclined too much outward, drawing with it the corresponding part of the palate, and the septum nasi, so that a very unsightly distortion of the nostril and nose is produced. Such cases are denominated *complicated hare-lips*.

A hare-lip, in its least degree, occasions considerable deformity; and when more marked, it frequently hinders infants from sucking, and makes it indispensable to nourish them by other means. When the lower lip alone is affected, which is rare as a malformation, the child can neither retain its saliva, nor learn to speak, except with the greatest impediment. The constant escape of the saliva, besides being an annoyance, is found to be detrimental to the health; for its loss impairs the digestive functions, the patient becomes emaciated, and even death would sometimes ensue, if the incessant discharge of so necessary a fluid in the animal economy were not prevented. Thus, a lady, who was in this state, consulted Tronchin, who immediately saw the cause of her indisposition, and recommended the fissure in the lip to be united: the operation was done, and the dyspeptic symptoms then ceased. And when the fissure pervades the palate, the patient not only articulates very imperfectly, but cannot masticate, nor swallow, except with great difficulty, on account of the food readily getting up into the nose.

An early removal of the deformity must obviously be very desirable; but as it cannot be accomplished without an operation, attended with some degree of pain, Dionis, Garengeot, and others, advise waiting till the child is four or five years old, on the supposition that, at an earlier age, the child's agitations and cries would render the operation impracticable, or derange all the proceedings taken to insure its success. It is plain, however, that such reasons are not of great weight. A child, four or five years old, and very often, even one eight or ten years of age, is more difficult to manage than an infant only a few months old. Every child of the above age has a thousand times more dread of the pain than of the deformity, or of the inconveniences of the complaint, to which he is habituated; while an infant of tender years fears nothing, and only feels the pain of the moment.

A more rational objection is the liability of infants to convulsions after operations; and this has induced many surgeons to postpone the cure of the hare-lip till the child is about two years old. This custom is also sanctioned by Sir Astley Cooper, who mentions in his lectures several instances, which have either been communicated to him by others, or have occurred in his own practice, where operations for the cure of hare-lips in very young infants have had a fatal termination, in consequence of an attack of convulsions, or diarrhœa. The period when dentition is completed, or the age of two years, he therefore sets down as the most advantageous for the operation; and if parents urge its being done earlier, he very properly advises the surgeon to let them be duly apprised of the risk, so that, in the event of the child being cut off, he may not incur blame for having operated at a disadvantageous period of life. About the end of 1823, I met Sir Astley Cooper in consultation in a case where this very question occurred. The deformity was particularly unsightly, in consequence of the upper jaw-bone being imperfectly ossified in front, and one side of it forming a considerable projection forwards through the fissure which extended into the nostril, at the same time that the nose was seriously distorted to one side of the face. The parents, persons of the first respectability, were therefore uncommonly solicitous for an early operation, some instances of the success of which in very young infants, had already been communicated to them by their friends. The projection of bone, they had also learned, might be cut away so as to permit the soft parts to meet, which they now would not do. The risk of an operation on the infant in question, then scarcely two months old, was fairly explained to the parents; but I doubt whether they could have been prevailed upon to wait three months longer, had not Sir Astley Cooper represented to them the disadvantages of cutting away the bony projection, and urged the allowance of a little time to reduce the protuberance by means of pressure. As I had not had any previous conference with Sir Astley on the subject, I was particularly gratified in finding his advice agree precisely with what I had already given, when the case was first shown to me. Exactly when the infant was five months old, a period selected on account of its being the latest previously to the usual time of the commencement of the ailments of dentition, I performed the operation in the presence of Mr. Ives, of Chertsey, and Mr. Ives, jun., of Chobham. By this time the bone had been so effectually depressed, by means of a kind of spring-truss, constructed by Messrs. Salmon and Ody for the purpose, and worn several hours daily, that the soft parts admitted of being brought over it with tolerable facility. Union followed very well, and, though it was one of the worst hare-lips ever seen by Mr. Ives, senior, or myself, without an extensive division of the palate, the disfigurement is now very trivial, and the wrong direction of the nose constantly undergoing further diminution, in proportion as the jaw recedes under the pressure of the apparatus, which is still employed. This is the youngest infant on which I have operated; but, in October, 1824, I performed the operation on an infant twelve months old, at Walton-on-Thames, where I was assisted by Mr. Stillwell. Union took place favourably, without any indisposition whatever. Only one pin was used, at the lower part of the lip, as I found that the upper part of the division could be perfectly and readily closed with a strip of adhesive plaster.

Le Dran performed the operation on children of all ages, even on those at the breast. B. Bell operated with success on an infant only three months old. Muys advises it to be undertaken as soon as the child is six months old. Roonhuysen operated on children ten weeks after their birth, and all his contemporaries praised his singular dexterity and success. As an essential step to the success of the operation, he recommended hindering the children from sleeping a certain length of time before it was undertaken, in order that they might fall asleep immediately afterwards; and with the same view opiates have been prescribed.

Baron Dupuytren deems it unsafe to operate on newborn children, because their flesh is so soft, that the pins readily cut through it, and because general mortality, independent of every particular cause, being at this age greater than at any other period of life, it would be imprudent to augment the chances of death, which hang over the young being, by an additional one resulting from the operation. On the whole, he infers, that the best period for operating is when the infant is three months old. (See *Clin. Chir.* t. iv. p. 90—92.)

Putting out of consideration the partial success, which has attended the use of blistering plaster, for making the edges of the fissure raw and capable of union, all practitioners entertain the same sentiment, with regard to the object of this operation, which consists in reducing the preternatural solution of continuity to the state of a simple wound, by cutting off the edges of the separated parts throughout their length, and then keeping these parts in contact until they have completely grown together. But, although such principles have been generally admitted, there was formerly some difference of opinion, with respect to the best method to be followed in practice; some operators having preferred sutures for keeping the edges of the wound in contact, while others disapproved of them, believing that a perfect cure might always be accomplished by means of adhesive plaster and an uniting bandage, so as to save the patient from all the pain and annoyance of sutures.

M. Louis thought that the use of sutures, in the operation for the hare-lip, proceeded from a false idea respecting the nature of the disease; for, the fissure in the lip being wrongly imputed to loss of substance, it was deemed impossible to keep the parts in contact except by a suture.

M. Louis lays it down as a fact, that, the retraction of the muscles being the cause of the separation of the edges of the fissure, it is not to these edges that the force which is to unite them should be applied; but to the very parts, whose action (the cause of the separation) is to be impeded. A great many means for supporting the wound, only irritate the muscles and excite them to action, and it is this action which we should endeavour to overcome. The means for promoting union, he says, can only be methodical, when directly employed to prevent such action, by an immediate application to the point where it is to be resisted. The facility with which the parts may be brought forward, so as to bring the two commissures of the lips into contact, by the mere pressure of the hands, shows what may be expected from a very simple apparatus, which will execute the same office without any effort, in a firm and permanent manner, and which will render sutures unnecessary, the inconveniences of which are too well known.

M. Louis, after having explained the reasons of the theory, on which he founded his method, details the history of twenty cases, in which his plan perfectly succeeded, both in accidental hare-lips, with considerable loss of substance, and in natural ones. In most of these instances, however, it was thought proper to assist the bandage with one stitch at the extremity of the fissure, close to the vermilion border of the lip, for the purpose of keeping the parts securely on a level. This fact seems to me a full admission of the practical advantages of a suture.

Notwithstanding the operation as performed with the twisted suture, is opposed by an authority of such weight as that of M. Louis, still it is the method now universally practised. No modern surgeons doubt that a hare-lip may be cured by means of adhesive plaster, and uniting bandages, quite as perfectly as with a suture; and all readily allow, that the first of these methods, as being more simple and less painful, would be preferable to the latter, if it were equally sure of succeeding. But it is considered far more uncertain in its effect. To accomplish a complete cure, the parts to be united must be maintained in perfect contact, until they have contracted the necessary adhesion; and how can we always depend upon a bandage for keeping them from being displaced? What other means, besides a suture, affords in this respect perfect security?

I shall first describe the operation as usually performed at the present day, with the twisted suture. The first thing is to examine whether there is any adhesion of the lip to the gum; and, if there be, to divide it with a knife. Some authors (*Sharp*) recommend the frænulum, which attaches the lip to the gum, always to be divided: but when the hare-lip is at some distance from this part, it will not be in the way of the operation, and need not be cut. On the other hand, when the frænulum is situated in the centre of the division, it should be divided beforehand. When one of the incisor teeth, opposite the fissure, projects forward, it must be drawn, lest it irritate the parts, after they have been brought into contact.

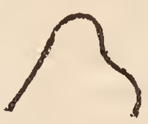
Sometimes, but particularly when a cleft exists in the bony part of the palate, a portion of the upper jaw forms such a projection, just in the situation of the fissure in the lip, that it would render the union very difficult, if not impracticable. In this circumstance, the common plan has been to cut off the projecting angles of bone with a strong pair of bone-nippers. The part was then healed, and the operation for the hare-lip performed. Cutting off the projection of bone leads to a diminution in the diameter of the bone, which no longer corresponds to the lower jaw bone, and great disfigurement, and even inconvenience in mastication, are the consequences. Hence, Desault used to employ simple compression, by which means the prominence was usually reduced in a few weeks, and the opportunity afforded of operating for the cure of the hare-lip. (*Œuvres Chir.* t. ii. p. 207.) Of course, the actual necessity of using bone-nippers, or even of having recourse to compression, will depend upon ~~circumstances~~; for if the prominence of bone be sharp and irregular, no surgeon, I conceive, would hesitate about the removal of such inequalities in preference to the trial of pressure. Mr. Dunn, of Scarborough, has expressed to me his doubts whether cutting off the projections of the alveolary process be ever necessary, as the pressure of the entire lip gradually diminishes the deformity. "I had (says he) two very unseemly cases, with an immense division of the palate, together with a projection of the alveolary process, which, with the incisor teeth, resembled the talons of a bird. A tubercular appendage of skin hung from the base of the nose. By drawing the teeth, in the first case, very delicately, I avoided fracturing the bony projection. I then cut off one edge of the nasal appendage, and of the lip on the same side, and attached them together with two needles. The wound was sufficiently united in a week or ten days to allow the same operation on the other side. In less than three weeks, the boy was sent home quite well, to the astonishment of the neighbourhood, where his frightful appearance had made him an object of disgust and ridicule. I succeeded in the other case even without the extraction of the teeth. Both the patients can now articulate labial sounds, retain their saliva, and are gradually losing the inconvenience of the passage of the mucus from the nose into the mouth, as the fissure is more contracted, and the projection by no means so disagreeable." These facts should lessen the haste with which certain operators proceed to cut off every projection of the alveolary process; for a moderate prominence of bone without any sharp, irritating edges, or angles, will not hinder the success of the operation; and even the propriety of removing teeth must entirely depend upon their being likely, by their direction, to irritate the lip, and disturb the union of the fissure.

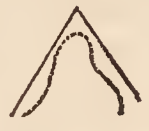
One serious objection to cutting away the projection of the jaw is the deformity afterwardy likely to continue during life from the deficienct of the incisores teeth; and another is the subsequens overlapping of the lower jaw, and its projection beyond the upper one; communicating to the mouth an appearance seen in very old subjects. These were the considerations which induced me, in the case above mentioned, to employ pressure, which is much more conveniently applied by means of a kind of spring-truss, adapted to the child's head, than with bandages, which would be seriously annoying, and the right action of which could not be regulated without the utmost difficulty. When also some of the bone must be cut away, on account of its roughness and angular prominences, I advise the practitioner to remove only the irritating points, and afterwards have recourse to pressure.

In a boy, thirteen years old, where the alveolary process jutted forward, M. Gensoul took hold of it with a strong pair of forceps, and brought it into the perpendicular position by main force. This rough method succeeded perfectly. (See *J. F. Malgaigne, in Manuel de Méd. Opér.* p. 444. ed. 2.)

Dupuytren had a particular method of operating in some cases of complicated hare-lip. He observed, that when the labial tubercle was inserted very close to the point of the nose, its union to the lateral parts drew the lip upwards, and exposed the gums and teeth; while the nose itself was pulled down and flattened in a most ugly manner. Hence he conceived, that it would be better to employ the labial tubercle in forming the lower part of the partition of the nose, and to unite at once the lateral portions of the lip. He first divided with a bistoury the fold of mucous membrane uniting the labial tubercle to the osseous one, and then, with a pair of cutting forceps, removed all such portions of the latter as projected beyond the anterior level of the jaws. He next pared off the sides of the cutaneous tubercle, and its lower edge. These things having been done, the vertical margin of the fissure, on each side, was cut off with a pair of scissors. The two lateral portions of the lip were now brought together, and united with two pins; and then the fresh-cut bleeding middle tubercle was laid over the bony partition of the nostrils, of which it was to form the lower portion. A third pin was applied, so as to include at once the upper end of each part of the lip, and the loose extremity of the reflected tubercle. Lastly, two interrupted sutures united the angles of this tubercle to the lateral portions of the lip. The sutures were assisted with strips of adhesive plaster, and a bandage, that made pressure on the apex of the nose, so as to keep the flap from being too much stretched. (See *Clin. Chir.* t. iv. p. 92.)

In the operation for single hare-lip, the grand object is to make as smooth and even a cut as possible, in order that it may more certainly unite by the first intention, and of such a shape, that the cicatrix may form only one narrow line. Hence in this country, the edges of the fissure are cut off with a sharp knife. One plan is to place any flat instrument, such as a piece of horn, wood, or pasteboard, underneath one portion of the lip, and then, holding the part stretched and supported on it, to cut away the whole of the callous edge. Another is to hold the part with a pair of forceps, the under blade of which is much broader than the upper one; the first serves to support the lip, the other contributes also to this effect, and, at the same time, serves as a sort of ruler for guiding the knife in an accurately straight line. When the forceps are preferred, the surgeon must of course leave out of the upper blade just as much of the edge of the fissure as is to be removed, so that it can be cut off with one sweep of the knife. This is to be done on each side of the cleft, observing the rule, to make the new wound in straight lines, because the sides of it can never be made to correspond without this caution. For instance, if the hare-lip has this shape, the incision of the edges must be continued in straight lines till they meet in the manner here represented. In short, the two incisions are to be perfectly straight, and are to meet at an angle above, in order that the whole track of the wound may be brought together, and united by the first intention.





In University College Hospital, the margins of the fissure are usually removed by transfixing the lip with a long sharp-pointed narrow bistoury just above the upper end of the cleft, and then cutting towards the red portion of the lip, while the part is held and stretched, by the surgeon himself, or his assistant. One side of the cleft is thus pared off, and then the other; particular care being taken to remove a small piece of the red part of the lip on each side, lest an ugly notch should be left in that situation. This is the plan ordinarily followed by Mr. Liston.

In France, the edges of the fissure are always taken off with a pair of strong, sharp, long-handled scissors, invented for the purpose by M. Dubois. (See *Alf. A. L. M. Velpeau in Nouv. Elém. de Méd. Opér.* t. ii. p. 4.; and *J. F. Malgaigne, in Manuel de Méd. Opér.* p. 442. ed. 2.) Scissors had an advocate in Desault, (*Œuvr. Chir.* t. ii. p. 179); and B. Bell was also in favour of them.

Two silver pins, made with steel points, which admit of easy removal, are next to be introduced through the edges of the wound, so as to keep them accurately in contact; the lowest pin being introduced first, near the inferior termination of the wound, and the upper pin afterwards, about a quarter of an inch higher up. A piece of thread is then to be repeatedly wound round the ends of the pins, from one side of the division to the other, first transversely, then obliquely, from the right or left end of one pin above, to the opposite end of the lower one, &c. Thus the thread is made to cross as many points of the wound as possible, which greatly contributes to maintaining its edges in even apposition, Lastly, the steel points of the pins are to be taken off, or, if not made to slide off, they are to be supported by small dossils of lint, placed between them and the skin. In University College Hospital, Mr. Liston employs largish common needles, the heads of which are dipped in sealing wax: and after they have transfixed the lip, he then takes off their points with a pair of cutting forceps. This plan removes all chance of the interruption sometimes caused by the steel points of silver pins not readily slipping off, when they have fulfilled their duty. Instead of pins, made with steel points, Dr. Barton, of Philadelphia, prefers using a piece of iron wire, with a point made by simply cutting it with a pair of scissors. Thus he avoids the risk of the steel point slipping off the pin, and remaining within the lip; an accident, which Dr. Reese states has often happened. "So many failures (says he) have occurred from the pins being torn out by the child, or catching in the nurse's clothes, that if there were no other objection to the use of pins, they ought to be abandoned. Many surgeons in this country (the United States), and among these, Dr. Mott, have adopted the interrupted suture in cases of hare-lip, and with the most satisfactory results." Notice is then taken of Sir Astley Cooper's relinquishment of the twisted suture. (See *Dr. Reese's Amer. ed. of this Dict.*)

It is obvious that a great deal of exactness is requisite in introducing the pins, in order that the edges of the incision may afterwards be precisely applied to each other. For this purpose, some surgeons previously place the sides of the wound in the best position, and mark with a pen the points at which the pins should enter, and come out again. The pins ought never to extend more deeply than about two-thirds through the substance of the lip, and it would be a great improvement always to have them of a flat, instead of a round shape, and a little curved, as this is the course which they naturally ought to take when introduced. The steel points should also admit of being easily taken off, when the pins have been applied; and, perhaps, having them to screw off and on, is the best mode, as removing them in this way is not so likely to be attended with any sudden jerk, which might be injurious to the wound, as if they were made to pull off. In general, the pins may be safely removed in about four days, when the support of sticking plaster will be quite sufficient.

After the operation, compresses and a bandage for keeping forward the cheeks, are sometimes employed; but they may in general be dispensed with, because irksome to children, and the occasion of restlessness.

The process just described is what is well known by the name of the *twisted suture*, which is applicable to other surgical cases, in which the grand object is to heal some fistula, or opening, by the first intention. Thus, as Mr. Sharp observes, it is of great service in fistulæ of the urethra, remaining after the operation for the stone, in which case the callous edges may be cut off, and the lips of the wound held together by the above method.

Although the generality of surgeons use the twisted suture, I ought to notice, that Sir Astley Cooper gives the preference to the common interrupted suture, on account of the difficulty sometimes experienced in withdrawing the pins, and the liability of the new adhesions to be broken on the occasion; whereas the threads of a common suture may be cut, and taken out with the greatest facility. However, as most children cry on the removal of the suture, whether one kind or the other be employed, the only safe plan is not to withdraw the pins or ligatures till three or four complete days have elapsed from the time of the operation, when the adhesions will be tolerably strong; and the cheeks should always be held forward by an assistant, until the plasters, and, if deemed necessary, compresses and a bandage, have been put on.

These observations particularly refer to the most simple form of the hare-lip, viz. to that which presents only one fissure. When there are two clefts, the cure is accomplished on the same principle; but it is rather more difficult of execution;

so that the old surgeons, until the time of Heister, almost all regarded the operation for the double hare-lip as impracticable: only a few described it, with the direction to operate on each fissure, just as if it were single. M. de la Faye operated in this way with success. (*Mém. de l'Acad. de Chir.* t. iv. 4to.) M. Louis was of opinion, that all difficulties would be obviated by doing the operation at two different times, and awaiting the perfect cure of one of the fissures, before that of the other was undertaken. Experience proves, however, that it is not essential to perform two operations for the cure of the double hare-lip. Desault found, that when the edges of the two fissures were pared off, and care taken to let one of the pins pass across the central piece of the lip, the practice answered extremely well. (See *Œuvres Chir.* t. ii. p. 201.)

In cutting off the edges of the fissure, the incision must be carried to the upper part of the lip; and even when the fissure does not reach wholly up the lip, the same thing should be done; for, in this manner, the sides of the wound will admit of being applied together more uniformly, and the cicatrix will have a better appearance. We should also not be too sparing of the edges which are to be cut off. Practitioners, says M. Louis, persuaded that the hare-lip was a division with loss of substance, have invariably advised the removal of the *callous* edges. But, in the natural hare-lip there is no callosity; the margins of the fissure are composed, like those of the lip itself, of a pulpy, fresh-coloured, vermilion flesh, covered with an exceedingly delicate cuticle. The whole of the part having this appearance must be taken away, together with a little of the true skin. At the lower part of the fissure, towards the nearest commissure, a rounded red substance is commonly situated, which it is absolutely necessary to include in the incision. Were this neglected, the union below would be unequal, and, through an injudicious economy, a degree of deformity would remain. The grand object, however, is to make the two incisions diverge at an acute angle, so that the edges may be put into reciprocal contact their whole length, without the least inequality.

The pins should be introduced at least two thirds of the way through the substance of the lip, lest a furrow should remain on the inside of the part, which might allow pieces of food to lodge in it. There is, however, a stronger reason for attending to this circumstance, viz. the hemorrhage which may take place when it is neglected. As soon as the edges of the wound have been brought together by means of the suture, and the pins are properly placed, the bleeding ceases; but, when the pins have not been introduced deeply enough, and the posterior surfaces of the incisions are not applied to each other, the blood may continue to run into the mouth, and give the surgeon an immense deal of trouble. In the memoir, written by Louis, there is a case, in which the patient died in consequence of such an accident. Persons who had undergone the operation were formerly advised to swallow their spittle, even though mixed with blood, in order to avoid disturbing the wound, by getting rid of it otherwise. In the case alluded to, the patient, who had been operated upon for a cancerous affection of the lip, swallowed the blood as he had been directed to do, and he bled so profusely that he died. On the examination of the body, the stomach and small intestines were found full of blood. "This deplorable case," says the illustrious author who relates it, "deserves to be recorded for public instruction, for the purpose of keeping alive the attention of surgeons on all occasions, where, in consequence of any operation whatsoever, there is reason to apprehend bleeding in the cavity of the mouth. Platner is the only writer who, so far as I know, foresaw this kind of danger."

What has been said concerning the operation for the hare-lip is equally applicable, not only to the treatment of cancer of the lip, but also to that of accidental cuts or lacerations of this part, from any cause whatsoever.

When there is a fissure in the bones forming the roof of the mouth, it usually diminishes, and gradually closes, after the hare-lip is cured. But this does not always happen; and when the parts remain so considerably separated, as to obstruct speech and deglutition, or cause any other inconvenience, a plate of gold or silver, exactly adapted to the arch of the palate, and steadied by means of a piece of sponge, fixed to its convex side, and introduced into the cleft, may sometimes be usefully employed. When the sponge is of suitable size, and very dry before before being used, the moisture of the adjacent parts will make it swell, and in many cases be sufficient to keep it in its situation, so as greatly to facilitate speaking and swallowing. Sometimes, however, the fissure is so shaped, that the sponge cannot be fixed in it; this principally happens when the opening widens very much towards the front of the jaw. In such cases it has been proposed to fix a plate of gold, by means of springs covered with the same metal. Platina, which is cheaper, might be used for the same purpose. The subject, however, of artificial palates, is one on which much mechanical ingenuity may yet be usefully exerted; and it can hardly be expected, that I should here do more than give references to works in which the reader may find information upon it.

See *Fauchard*, Le Chirurgien-Dentiste, 2 tom. 12mo. Paris, 1728. *Camper*, Vermischte Schriften, No. 13. *Loder*'s Journ. b. ii. p. 25. p. 185, &c. *Von Sieveling* über eine merkwürdige kunstliche Ersetzung mehrerer, sowohl zur Sprache, als zum Schlucken nothwendiger, zerstörter Werkzeuge; 8vo. Heidelb. 1793. *Siebold*, Chir. Tagebuch, No. 20. *J. H. F. Autenrieth*, Supplementa ad Hist. Embryonis Humani. quibus accedunt Observata quædam circa Palatum fissum, verosimillimamque illi medendi Methodum, 4to. Tubing. 1797. *Cullerion*, in Journ. Gén. &c. t. xix. *Recueil*, Périod. &c. t. xi. p. 22. Dict. des Sciences Méd. t. xxxvii. art. Obturateur. *C. Graefe* et *Ph. von Walther*, Journ. der Chir. b. i. p. 1. 8vo. Berlin, 1820: in this work, *Graefe* has described a method of curing fissures in the soft palate by means of a particular kind of suture, with the various instruments necessary in the operation. *James Snell*, Obs. on Artificial Palates, 8vo. Lond. 1828.

For information relative to the hare-lip, see *B. Bell*'s Surgery, vol. iv. *Heister*'s Surgery. *Le Dran*'s Operations. *Sharp*'s Operations. *F. D. Herissant*, Mém. de l'Acad. des Sciences, année 1743. p. 86.: a very curious case, complicated with a fissure in the palate, and two oblong apertures at the sides of this cleft. In play, the child would sometimes fill his mouth with water, and, through those apertures, let it spout out at the nostrils, in imitation of what takes place in whales. *G. De la Faye*, Mém. de l'Acad. Royale de Chir. t. i. p. 605. année 1743. *E. Sandifort*, Obs. Anat. Pathol. 4to. et Museum Anat. p. 110, 164. Ludg. Bat. 1777. *Flajani*, Collezione d'Osserv., &c. t. iv. 8vo. Roma. *Latta*'s Surgery, vol. ii. *Louis*, in Mém. de l'Acad. de Chir. t. iv. p. 385. 4to. année 1768; t. v. p. 292. année 1774. De la Médecine Operatoire, par Sabatier, t. iii. p. 272. 8vo. Paris, 1810. Œuvres Chir. de *Desault*, par *Bichat*, t. ii. p. 173. Traité des Opérations de Chirurgie, par *A. Bertrandi*, chap. 19. *P. N. Haguette*, Sur le Bec-de-lièvre naturel, 4to. Paris, 1804. *J. Kirby*, Cases, &c. 8vo. Lond. 1819: forceps recommended for holding the lip in the operation. *Richter*, Anfangsgr. der Wundarzn. b. ii. kap. 7. *Locher*, de Operatione labii leporini. Jenæ, 1792. *Fretur*, de Labio leporino. Halæ. 1793. Rieg., von der Hasenscharte. Frankf. 1803. *M. J. Chelius*, Handb. der Chir. b. i. p. 425. Heidelb. 1826. *Sprengel*, Geschichte der Chir. Operationen, b. i. p. 155. *Graefe*, Angiectasie, v. Langenbeck Bibl. b. ii. p. 359. *Eckoldt*, Ueber eine sehr complicirte Hasenscharte, Leipz. 1804. fol. *Sir Astley Cooper*'s Lectures, ed. by *Tyrrell*. *Baron Dupuytren*, in Leçons Orales de Clin. Chir. t. iv. p. 89. *R. Liston*, in Elements of Surgery. *Alf. Velpeau*, Nouv. Elém. de Méd. Opér. t. ii. art. 1. 8vo. Paris, 1832. *J. F. Malgaigne*, Manuel de Méd. Opér. p. 439. ed. 2. 12mo. Paris, 1837.

HEAD, INJURIES OF THE. 1. From the variety of parts of which the scalp is composed, from their structure, connections, and uses, injuries done to it by external violence become of much more consequence, than the same kind of ills can prove, when inflicted on the common integuments of the rest of the body. One principal reason of the danger in these cases depends upon the free communication between the vessels of the pericranium, and those of the dura mater, through the diploe of the skull; for, when inflammation is kindled in the former membrane, it may extend itself to the latter. According to Sir Astley Cooper, there are three modes in which wounds of the scalp may induce fatal consequences:—1st, by exciting erysipelatous inflammation; 2dly, by producing extensive suppuration under the tendon of the occipito-frontalis; 3dly, by rendering a simple fracture compound, so as to cause more extensive inflammation of the dura mater. (*Lectures*, vol. i. p. 350.) The latter observation, so far as my information reaches, is new, and deserves the serious consideration of the practitioner; for, in the great hospital where I was educated, and in all the practice which I have seen in the army and elsewhere, no analogy of this kind was ever suspected between ordinary compound fractures and those of the cranium. If the doctrine be correct, it forms another weighty argument against the method of cutting down to a fracture of the skull, without urgent motives.

Incised wounds of the scalp are, indeed, less liable than contused and lacerated ones, to produce bad consequences; but they are not entirely devoid of danger; in proof of which Sir Astley Cooper mentions the case of a lady of rank in the country, who died from the removal of an encysted tumour of the scalp. (*Lectures*, vol. i. p. 349.) I have seen several unfortunate cases of this kind both in hospitals and out of them. We know, in fact, that the scalp is a part frequently attacked by erysipelas, and this after very slight injuries. Passing over incised wounds, however, which generally heal as well as the generality of cuts of other parts of the skin, and require no particularity of treatment, I will proceed to the consideration of lacerated and punctured wounds. "The former may be reduced to two kinds: viz. those in which the scalp, though torn, or unequally divided, still keeps its natural situation, and is not stripped nor separated from the cranium, to any considerable distance beyond the breadth of the wound; and those in which it is considerably detached from the parts it ought to cover. The first of these, if simple, and not combined with the symptoms, or appearances of any other mischief, does not require any particular or different treatment, from what the same kind of wounds require in all other parts;" but with respect to those in which the scalp is separated and detached from the parts it ought to cover, Mr. Pott makes no scruple of declaring it as his opinion, that its preservation ought always to be attempted, *unless it be so torn as to be absolutely spoiled, or there are manifest present symptoms of other mischief.* In former days, the excision of the lacerated and detached scalp was the general practice; but Mr. Pott had so often made the experiment of endeavouring to preserve the torn piece, and so often succeeded, that he recommended it as a thing always to be attempted, even though a part of the cranium were perfectly bare.

Here I may remark that all practitioners now invariably avoid cutting away the scalp, even in the circumstances in which such practice was allowed by Pott. By *spoiled* this eminent writer must mean so injured as necessarily to slough afterwards. However, as no harm results from taking the chance of its not sloughing, which never can be foretold with certainty; and as the excision of the part is painful, and productive of no benefit, even if sloughing must follow, such operation is in every point of view hurtful and wrong. With respect to other mischief, as a reason, the examination of the cranium, and even the application of the trephine, never require any of the scalp to be cut away. (See TREPHINE.)

Let the surgeon, therefore, free the torn piece from all dirt, or foreign bodies, and restore it as quickly, and as perfectly, as he can to its natural situation, and keep it there with strips of adhesive plaster, and, if necessary, with sutures, which are chiefly useful for maintaining the angles of the flap, in their right position. As few sutures, however, as possible should be employed, because they augment the irritation and the chances of erysipelas.

Sometimes the loosened scalp will unite with the parts from which it is torn and separated, and there will be no other granulating surface, than what arises from the impracticability of bringing the lips of the wound into smooth and immediate contact, the scar of which surface must be small in proportion.

In some cases, the whole separated piece will unite perfectly, and give little or no trouble, especially in young and healthy persons. In some, the union will take place in certain parts and not in others (also Sir B. Brodie, in *Med. Chir. Trans.* vol. xiv. p. 408.), and consequently matter will be formed, and require to be discharged, perhaps at several different points; and in some particular cases, circumstances, and habits, there will be no union at all; the torn cellular tissue, or the naked aponeurosis, will inflame and become sloughy, a considerable quantity of matter will be collected, and, perhaps, the cranium will be denuded. But even in this state of things, which as, Pott observes, is almost the worst that can happen in the case of mere simple laceration and detachment, the surgeon will often find the cure much more feasible than he may at first imagine: let him take care to keep the inflammation under by proper means; let him have patience till the matter is fairly and fully formed, and the sloughs perfectly separated; and when this is accomplished, let him make a proper number of dependent openings for the discharge of them; and let him by bandage, and other proper management, keep the parts in constant contact with each other; and he will often find, that although he was foiled in his first intention of procuring immediate union, yet he will frequently succeed in this his second; he will yet save the scalp, shorten the cure, and prevent the great deformity arising (particularly to women) not only from the scar, but from the total loss of hair.

This union may often be procured, even though the cranium should have been perfectly denuded by the accident; and it is true, not only though it should have been stripped of its pericranium at first, (see *Abernethy on the Injuries of the Head*, case 6.) but even if that pericranium should have become sloughy and cast off, as Pott and every surgeon of experience have often seen.

"Exfoliation from a cranium laid bare by external violence, and to which no other injury has been done than merely stripping it of its covering, is a circumstance (says Pott) which would not so often happen if it was not taken for granted that it must be, and the bone treated according to such expectation. The soft open texture of the bones of children and young people will frequently furnish an incarnation, which will cover their surface, and render exfoliation quite unnecessary (see Sir B. Brodie, in *Med. Chir. Trans.* vol. xiv. p. 409.); and even in those of mature age, and in whom the bones are still harder, exfoliation is full as often the effect of art as the intention of nature, and produced by a method of dressing calculated to accomplish such end, under a supposition of its being necessary. Sometimes, indeed, it happens that a small scale will necessarily separate, and the sore cannot be perfectly healed till such separation has been made; but this kind of exfoliation will be very small and thin, in proportion to that produced by art, that is, by dressing the surface of the bare bone with spirituous tinctures, &c.

In some of these instances, the exfoliation takes place as it were imperceptibly. In University College Hospital, I have had several cases in which, though a portion of dead bone was plainly felt for a time, it ultimately disappeared, and the wound healed up. M. Velpeau has often observed the same thing in the hospitals of Paris, and this not only with respect to small superficial necroses of the cranium, but those of other bones. (See *Alf. A. M. L. Velpeau, De l'Opération du Trepan, &c.*, p. 20.) On this point my experience entirely coincides with that of M. Velpeau. In such cases, is the scale of bone absorbed? or is it dissolved, and does it come away unperceived in minute particles with the discharge? M. Velpeau believes, that there is a dissolution, and not an imperceptible exfoliation. "In certain cases (says he), there does not appear to be any exfoliation, although the denuded surface of the bone has been for a long time in contact with the air, or pus. In other instances a fine scale is separated, which is either insensibly destroyed by the soft parts, or passes out. Lastly, in some persons, the dead layer of bone, though very thick, ceases to excite suppuration, and yields to the molecular action of the textures. These are phenomena (he observes) which deprive the pericranium of a great deal of that influence, which has been assigned to it in the reproduction of bone, and the formation of necroses." (*Op.* cit. p. 21.)

Wounds made by bodies which pierce, or puncture rather than cut, are, in general, more apt to become inflamed, and to give trouble, than those which are larger. In particular, simple and phlegmonous erysipelas of the head are frequent consequences of such injuries, in constitutions predisposed to them, either naturally, or from the influence of atmospheric causes, or intemperance. Having already considered this subject (see Erysipelas), I need not here expatiate upon it. Let us notice, however, the observation of Pott, that in erysipelas of the head from a wound, he believed bark to be never productive of any decided benefit. He confided entirely in antiphlogistic means. Where also the cellular tissue, under the tendon of the occipito-frontalis, was implicated, as it is in some examples of phlegmonous erysipelas, he found that a simple incision down to the bone would most commonly remove all the bad symptoms; a remark meriting attention, with reference to the modern revival of the practice of incisions in this disorder, which, indeed, are mentioned by Freind.

"When the scalp receives a very smart blow, it often happens that a quantity of extravasated blood immediately forms a tumour, easily distinguishable from all others, and generally very easily cured. But it also sometimes happens, that this kind of tumour produces to the fingers of an unadvised or inattentive examiner, a sensation so like to that of a fracture, with depression of the cranium, as may be easily mistaken." Now, if, upon such supposition, a surgeon immediately makes an incision into the tumid scalp, he may give his patient a great deal of unnecessary pain, and for that reason run some risk of his own character.

"The touch is in this case so liable to deception, that recourse should always be had to other circumstances and symptoms, before an opinion be given.

"If a person, with such tumour occasioned by a blow, and attended with such appearances and feel, has any complaint, which seems to be the effect of pressure made on the brain and nerves, or of any mischief done to the parts within the cranium, the division of the scalp, in order to inquire into the state of the skull, is right and necessary; but if there are no such general symptoms, and the patient is in every respect perfectly well, the mere feel of something like a fracture will not authorise or vindicate such operation, since it will often be found, that such sensation is a deception, and that, when the extravasated fluid is removed, or dissipated, the cranium is perfectly sound and uninjured." (*Pott.*)

When blood is extravasated under the scalp, the surgeon need not be too officious with his knife, merely because there is a tumour containing blood. The facility, with which an effusion of blood under the scalp is dispersed, is well illustrated in a case mentioned by Sir Benjamin Brodie. He was consulted about a young gentleman, under whose scalp an effusion of blood extended from the superciliary ridges to the nape of the neck, and from ear to ear. The blood appeared to be in a fluid state, and was so copious, that no part of the cranium could be felt. In a few weeks, and with the aid of a cold lotion, the whole tumour was dispersed. Sir Benjamin Brodie observes, that whatever might be the vessel ruptured, it must have continued to bleed a considerable time, in order to produce so large an extravasation. I have seen three or four cases, nearly as remarkable as the preceding, and having a similar favourable termination under the use of simple discutient lotions and occasional purgatives. In one instance, attended by Sir B. Brodie, he succeeded in preventing the effusion from attaining the extent described in his other case, by means of pressure applied to the point where the blow had been received, and a vessel ruptured. (See *Med. Chir. Trans.* vol. xv. p. 406.)

In wounds of the head, Dr. Hennen has very properly advised surgeons not to be content with clipping away a little of the hair around the injury, but always to have the head shaved to a proper extent. This proceeding, which is perfectly harmless in itself, is more generally right, than the custom of cutting the scalp, which has been too frequently employed without any rational aim. The free removal of the hair, directly after the accident, often brings into view marks indicative of other parts of the head having been struck, besides that which is at first noticed; and thus the practitioner will have a more correct notion of the serious nature of the accident, than he might otherwise have conceived, and be more strict in his mode of treatment. Nay, fractures and depression of the skull, sometimes not denoted by any disturbance of the functions of the brain, and liable to escape observation, while concealed under the hair, are frequently detected after its removal; and the surgeon, being now aware of the extent and situation of the mischief, must of course be better qualified to conduct the treatment. In short, as Dr. Hennen has observed, "independent of the more accurate view (thus procured), we facilitate the application of leeches, if they may be found necessary, and of a most excellent adjuvant on all occasions, viz. cold applications."

It affords me particular pleasure to be able to number so good a surgeon as Dr. Hennen amongst the advocates of Schmucker's plan of having the head well shaved and covered with clothes wet with a very cold lotion; a practice which the latter eminent surgeon always adopted, whether a sabre-cut or gunshot injury of this part had the appearance of being serious or not. "As soon as the patient was brought to the hospital with a wound of the head, whether the injury looked important or not (says Schmucker), I directed the hair to be immediately removed, and, after the necessary dilatation, applied dressings. Sixteen ounces of blood were next taken away, and the evacuation, in less quantity, repeated, according to circumstances, three or four times, within the space of twenty-four hours. The pulse now generally became softer, and the determination of blood to the head lessened. Over the dressings, and the whole of the head, thick cloths, dipped in the cold mixture hereafter specified, were laid, and renewed every hour. These cloths were kept in their place with the bandage called the grand couvre-chef. (See Bandage.) As internal medicines, the nitrate of potassa, neutral salts, and emollient and stimulating clysters, and gentle aperients were given. These means were employed, both in slight injuries, and in those where the bones were depressed, and fissures and fractures were accompanied with violent convulsive twitches, coma, paralysis, and other bad symptoms; and even in cases where the use of the trephine was indispensable, the practice was continued until the cure was complete." Schmucker assures us, that, under such treatment, fewer patients with wounds of the head were lost than used previously to happen, especially of those whose injuries at first had the appearance of being but slight. (See *Chir. Wahrnehmungen*, b. i. p. 154.)

Schmucker was led to try this practice by the decided benefit which he had seen afforded by the application of cold water to the head in cases of mania, attended with great determination of blood to the brain. And, in order to increase the efficacy of the water, he added to every five gallons of it two quarts of vinegar, sixteen ounces of nitre, and eight of the muriate of ammonia. This mixture was then preserved for use in a cold place. (Vol. cit. p. 153.) Or, in order to avail ourselves fully of the frigorific effects of this mixture, it should be prepared, as Dr. Hennen observes, in small quantities, and used immediately, before its temperature has risen; or, "snow, or pounded ice, or ice-water applied to the parts in a half-filled bladder, or cloths simply dipped in cold water, will often answer every purpose." (*On Military Surgery*, p. 279. ed. 2.) Dr. Hennen mentions one important fact, in recommendation of cold applications, antimonials, and saline purgatives, preceded by the common blue pill, and assisted with quiet and abstinence, viz. by such means "those troublesome puffy enlargements and erysipelatous affections of the scalp, which so often succeed to bruises," are prevented, and where the evacuant plan is duly observed, the extensive and formidable erysipelatous affections, so common formerly, are rare and mild at present in military hospitals." Let this be a lesson to those, who have charge of civil ones.

2. Effects of Contusion on the Dura Mater and Parts within the Skull.

In consequence of blows, falls, and other shocks, either blood may be effused under the cranium, or inflammation and suppuration of the dura mater may arise. The best description of the latter case is that delivered by Mr. Pott.

Smart and severe strokes on the middle part of the bones, at a distance from the sutures, he says, are most frequently followed by this kind of mischief; the coats of the small vessels, which sustain the injury, inflame and become sloughy, and, in consequence of such alteration in them, the pericranium separates from the outside of that part of the bone which received the blow, and the dura mater from the inside, the latter of which membranes, soon after such inflammation, becomes sloughy also, and furnishes matter, which matter being collected between the said membrane and the cranium, and having no natural outlet, whereby to escape or be discharged, brings on a train of very terrible symptoms, and is a frequent cause of destruction. The effect of this kind of violence is frequently confined to the vessels connecting the dura mater to the cranium, in which case the matter is external to the said membrane; but sometimes the matter formed in consequence of such violence is found on the surface of the brain, or between the pia and dura mater, as well as on the surface of the latter; or, perhaps, in all these three situations at the same time.

The difference of this kind of disease from either an extravasation of blood, or a concussion of the brain, is great and obvious. "All the complaints produced by extravasation are such as proceed from pressure made on the brain and nerves, and obstruction to the circulation of the blood through the former; stupidity, loss of sense and voluntary motion, laborious and obstructed pulse and respiration, &c. and (which is of importance to remark), *if the effusion be at all considerable, these symptoms appear immediately, or very soon after the accident.*

"The symptoms attending an inflamed or sloughy state of the membranes, in consequence of external violence, are very different; they are all of the febrile kind, and never, at first, imply any unnatural pressure: such are, pain in the head, restlessness, want of sleep, frequent and hard pulse, hot and dry skin, flushed countenance, inflamed eyes, nausea, vomiting, rigor, and toward the end, convulsion and delirium. And *none of these appear at first, that is, immediately after the accident; seldom until some days are passed.*"

This last observation, made by Pott, is one that is well worthy of the practitioner's constant recollection, lest he wrongly fancy his patient secure too soon, and neglect the early use of the only means by which a recovery can be effected. Thus, as Sir Astley Cooper notices, the time when inflammation of the brain (and it may be added of its membranes) follows the violence, is generally about a week; rarely sooner. Frequently, it does not come on till a fortnight or three weeks after the injury; and even more time must elapse before the patient is quite safe, or ought to deviate from a strict and temperate regimen. In confirmation of this remark, a case is mentioned, where the neglect to keep the bowels regular brought on a fatal attack of inflammation of the brain, as late as four months after the receipt of a blow on the head. (*Lectures, &c.*, p. 339.) In University College Hospital, I have had several cases in which the bad symptoms began at very late periods after the accident.

One set or class of symptoms is produced by an extravasated fluid, making pressure on the brain and origin of the nerves, so as to impair or abolish voluntary motion and the senses; the other is caused by the inflamed or putrid state of the membranes covering the brain, and seldom affects the organs of sense until the latter end of the disease, that is, until a considerable quantity of matter is formed, which matter must press like any other fluid.

"If there be neither fissure nor fracture of the skull, nor extravasation, nor commotion underneath it, and the scalp be neither considerably bruised nor wounded, the mischief is seldom discovered or attended to for some few days. The first attack is generally by pain in the part which received the blow. This pain, though beginning in that point, is soon extended all over the head, and is attended with a languor, or dejection of strength and spirits, which are soon followed by a nausea, and inclination to vomit, a vertigo or giddiness, a quick and hard pulse, and an incapacity of sleeping, at least quietly. A day or two after this attack, if no means preventive of inflammation are used, the part stricken generally swells, and becomes puffy and tender, but not painful; neither does the tumour arise to any considerable height, nor spread to any great extent: if this tumid part of the scalp be now divided, the pericranium will be found of a darkish hue, and either quite detached, or very easily separable from the skull, between which and it will be found a small quantity of dark-coloured ichor.

"If the disorder has made such progress that the pericranium is quite separated and detached from the skull, the latter will even now be found to be somewhat altered in colour from a sound healthy bone.

"From this time the symptoms generally advance more hastily and more apparently; the fever increases, the skin becomes hotter, the pulse quicker and harder, the sleep more disturbed, the anxiety and restlessness more fatiguing; and to these are generally added irregular rigors, which are not followed by any critical sweat, and which instead of relieving the patient, add considerably to his sufferings. If the scalp has not been divided or removed, until the symptoms are thus far advanced, the alteration of the colour of the bone will be found to be more remarkable; it will be found to be whiter and more dry than a healthy one; or, as Fallopius has very justly observed, it will be found to be more like a dead bone: the sanies, or fluid, between it and the pericranium, will also, in this state, be found to be more in quantity, and the said membrane will have a more livid diseased aspect.

"In this state of matters, if the dura mater be denuded, it will be found to be detached from the inside of the cranium, to have lost its bright silver hue, and to be, as it were, smeared over with a kind of mucus, or with matter, but not with blood. Every hour after this period all the symptoms are exasperated, and advance with hasty strides; the headach and thirst become more intense, the strength decreases, the rigors are more frequent, and at last convulsive motions, attended in some with delirium, in others with paralysis, or comatose stupidity, finish the tragedy.

"If the scalp has not been divided till this point of time, and it be done now, a very offensive discoloured kind of fluid will be found lying on the bare cranium, whose appearance will be still more unlike to the healthy natural one; if the bone be now perforated, matter will be found between it and the dura mater, generally in considerable quantity, but different in different cases and circumstances. Sometimes it will be in great abundance, and diffused over a very large part of the membrane; and sometimes the quantity will be less, and consequently the space which it occupies smaller. Sometimes it lies only on the exterior surface of the dura mater, and sometimes it is between it and the pia mater, or also even on the surface of the brain, or within the substance of it, &c.

"As the inflammation and separation of the dura mater is not an *immediate* consequence of the violence, so neither are the symptoms immediate, seldom until some days have passed; the fever at first is slight, but increases gradually; as the membrane becomes more and more diseased, all the febrile symptoms are heightened; the formation of matter occasions rigors, frequent and irregular, until such a quantity is collected as brings on delirium, spasm, and death."

When the scalp has been wounded, Mr. Pott observes, the wound will for some little time have the same appearance as a mere simple wound of this part, unattended with other mischief would have; it will, like that, at first discharge a thin sanies, or gleet, and then begin to suppurate; it will digest, begin to incarn, and look perfectly well; but, after a few days, all these favourable appearances will vanish; the sore will lose its florid complexion and granulated surface; will become pale, glassy, and flabby; instead of good matter, it will discharge only a thin discoloured sanies; the lint with which it is dressed, instead of coming off easily (as in a kindly suppurating sore), will stick to all parts of it; and the pericranium, instead of adhering firmly to the bone, will separate from it, all round, to some distance from the edges.

"This alteration in the face and circumstances of the sore is produced merely by the diseased state of the parts underneath the skull; which is a circumstance of great importance, in support of the doctrine advanced, and is demonstrably proved, by observing that this diseased aspect of the sore, and this spontaneous separation of the pericranium, are always confined to that part which covers the altered or injured portion of the dura mater, and do not at all affect the rest of the scalp: nay, if it has by accident been wounded in any other part, or a portion has been removed from any part where no injury has been done to the dura mater, no such separation will happen.

"The first appearance of alteration in the wound immediately succeeds the febrile attack; and as the febrile symptoms increase, the wound becomes worse and worse; that is, degenerates more and more from a healthy, kindly aspect." (*Pott.*)

The same intelligent surgeon further observes "that it is no very uncommon thing for a smart blow on the head to produce some immediate bad symptoms, which after a short space of time disappear, and leave the patient perfectly well. A slight pain in the head, a little acceleration of pulse, a vertigo and sickness, sometimes immediately follow such accident, but do not continue many hours, especially if any evacuation has been used. These are not improbably owing to a light commotion of the brain, which, having suffered no material injury thereby, soon cease. But if, after an interval of some time, the same symptoms are renewed; if the patient, having been well, becomes again feverish and restless, and that without any new cause; if he complains of being languid and uneasy, sleeps disturbedly, loses his appetite, has a hot skin, a hard quick pulse, and a flushed, heated countenance; and neither irregularity of diet nor accidental cold have been productive of these; mischief is most certainly impending, and that most probably under the skull.

"If the symptoms of pressure, such as stupidity, loss of sense, voluntary motion, &c. appear some few days after the head has suffered injury from external mischief, they do most probably imply an effusion of a fluid somewhere; this effusion may be in the substance of the brain, in its ventricles, between its membranes, or on the surface of the dura mater; and which of these is the real situation of such extravasation is a matter of great uncertainty, none of them being attended with any peculiar mark or sign that can be depended upon, as pointing it out precisely; but the inflammation of the dura mater, and the formation of matter between it and the skull, in consequence of contusion, is generally indicated and preceded by one which Mr. Pott has hardly ever known to fail; *a puffy, circumscribed, indolent tumour of the scalp, and a spontaneous separation of the pericranium from the skull under such tumour.*"

Sometimes the scalp is so wounded at the time of the accident, or so torn away, as to leave the bone perfectly bare; and yet no suppuration on the dura mater may ensue. Hence, if the pericranium be only turned back, along with the detached portion of scalp, there may be probability of its re-union; and it should be immediately made clean and replaced, for the purpose of such experiment; which, if it succeeds, will save time, and prevent considerable deformity. Should the attempt fail, it can only be in consequence of the detached part sloughing. Hence, removing it with a knife, though allowed by Pott, is now never practised. Frequently, when the scalp does not adhere at once, it becomes attached to the cranium afterwards by a granulating process. When the detached piece sloughs, the worst that can happen is an exfoliation from the bare skull.

Sometimes the force, which detaches or removes the scalp, also occasions the mischief in question; but the integuments being wounded or removed, we cannot have the criterion of the tumour of the scalp for the direction of our judgment. Our whole attention must be directed to the wound and general symptoms. The edges of the former will digest as well, and look as kindly for a few days, as if no mischief was done underneath. But after some little space of time, when the patient begins to be restless, and hot, and to complain of pain in the head, these edges will lose their vermilion hue, and become pale and flabby. Instead of matter, they will discharge a thin gleet, and the pericranium will loosen from the skull to some distance from the said edges. Immediately after this, all the general symptoms are increased and exasperated; and as the inflammation of the membrane is heightened or extended, they become daily worse and worse, until a quantity of matter is formed and collected, and brings on that fatal period, which, though uncertain as to date, very seldom fails to arrive.

"The method of attempting the relief of this kind of injury consists in two points: viz. *to endeavour to prevent the inflammation of the dura mater*; or, that being neglected, or found impracticable, *to give discharge to the fluid collected within the cranium, in consequence of such inflammation.*

"Of all the remedies in the power of art, for inflammations of membranous parts, there is none equal to phlebotomy. To this truth many diseases bear testimony; pleurisies, ophthalmies, strangulated hernias, &c.; and if any thing can particularly contribute to the prevention of the ills likely to follow severe contusions of the head, it is this kind of evacuation; but then it must be made use of in such a manner as to become truly a preventive; that is, it must be made use of immediately and freely."

Acceleration or hardness of pulse, restlessness, anxiety, and any degree of fever, after a smart blow on the head, are always to be suspected and attended to. Immediate, plentiful, and repeated evacuations by bleeding have, in many instances, removed these, in persons to whom, Mr. Pott firmly believes, terrible mischief would have happened, had not such precaution been used. In this, as well as some other parts of practice, we neither have, nor can have, any other method of judging, than by comparing together cases apparently similar. Mr. Pott had more than once or twice seen that increased velocity and hardness of pulse, and that oppressive languor which most frequently precede mischief under the bone, removed by free and repeated bloodletting; and had often, much too often, seen cases end fatally, whose beginnings were fully as slight, but in which such evacuation had been either neglected, or not complied with. This judicious writer "would by no means be thought to infer from hence, that early bleeding will always prove a certain preservative; and that they only die to whom it has not been applied: this, like all other human means, is fallible; and, perhaps, there are more cases out of its reach than within it: but where preventive means can take place, this is certainly the best, and the most frequently successful.

"The second intention, viz. *the discharge of matter collected under the cranium*, can be answered only by the perforation of it.

"When, from the symptoms and appearances already described, there is just reason for supposing matter to be formed under the skull, the operation of perforation cannot be performed too soon; it seldom happens that it is done soon enough."

In short, whenever the dura mater, after the head has received external violence, separates, or is detached spontaneously, from the bone underneath it, and such separation is attended with the collection of a small quantity of thin brown ichor, an alteration of colour in the separated pericranium, unnatural dryness of the bone, chilliness, horripilatio, languor, and some degree of fever, Mr. Pott considers the operation indispensably necessary to save the patient's life.

"When the skull has been once perforated, and the dura mater thereby laid bare, the state of the matter must principally determine the surgeon's future conduct. In some cases, one opening will prove sufficient for all necessary purposes; in others, several may be necessary."

Notwithstanding the operation of perforation be absolutely and unavoidably necessary, as Mr. Pott remarks, "the repetition of bloodletting, or cooling laxative medicines, the use of antiphlogistic remedies, and a most strict observance of a low diet and regimen, are as indispensably requisite after such operation as before: the perforation sets the membrane free from pressure, and gives vent to collected matter, but nothing more; the inflamed state of the parts under the skull, and all the necessary consequences of such inflammation, call for all our attention, full as much afterwards as before; and although the patient must have perished without the use of the trephine, yet the merely having used it will not preserve him without every other caution and care." (*Pott.*)

In relation to this subject, a remark, made by Sir Astley Cooper, merits notice: when pus lies between the dura mater and skull, the application of the trephine, he acknowledges, is a successful practice; but, according to his experience, this situation of the purulent matter is comparatively rare, as it generally collects between the pia mater and surface of the brain, *for which case an operation will be useless.* (*Lectures, &c.* vol. i. p. 325.) It is stated by Sir Benjamin Brodie, that in hospital practice, suppuration between the dura mater and the bone, in consequence of fracture, is also less common at the present period, than when Pott wrote; a change which he refers to the stricter antiphlogistic plan adopted by modern surgeons, whether the early symptoms be or be not of a dangerous description. (See *Med. Chir. Trans.* vol. xiv. p. 411.)

My own observations agree with those of Sir Astley Cooper, respecting the greater frequency of purulent matter under, than upon the dura mater. Some months ago, I trephined a patient who had paralysis and other symptoms of pressure, preceded by those of inflammation within the skull. I was partly induced to do so for the purpose of removing a necrosis, which, I conceived, might extend through both tables, and be a source of irritation. The matter, however, was not under the sequestrum which consisted merely of the outer table, but was diffused both between the arachnoid coat and dura mater, and also more deeply over the pia mater. The operation was therefore useless. In two other cases, which proved fatal, in University College Hospital, there was, indeed, pus on the surface of the dura mater; but there were also abscesses in the substance of the brain. Two fine specimens of this are preserved in the College Museum. Suppuration on the dura mater, though demanding the trephine, will often fail, not merely on account of the circumstances here adverted to, but because the brain and its membranes are actually in a state of inflammation. The matter may be discharged, but its pressure is not the only mischief. La Peyronie relates a case, in which an incision was made in the dura mater, and a basin of pus discharged, leaving a cavity that reached to the corpus callosum. The patient recovered. (*Acad. de Chir.* t. i. p. 250.) Baron Dupuytren ventured in one instance to make a puncture, an inch deep, in the brain, and was fortunate enough to reach the abscess: the case ended well. (*Pathol. Med. Ch.* t. iv. p. 308.)

I think it not improper to recommend again the practice of applying cold wet cloths to the head for the prevention and relief of imflammation of the dura mater; a plan to which, as already explained, Schmucker ascribed a good deal of the success with which he treated injuries of the head. It is favourably mentioned by Dr. Hennen, and has received the recommendation of another modern writer, whose opinion must have great weight: "In the inflammation, which succeeds slowly to injuries of the head, a species of inflammation not more insidious in its approach than dangerous in its consequences, cold is by far the most efficacious remedy that has yet been discovered." (See *Thomson's Lectures on Inflammation*, p. 181.)

Both tables of the skull sometimes exfoliate in consequence of external violence. Here the dead bone must be removed, as soon as loose; and, if necessary, the scalp divided for the purpose. M. Velpeau sets down this as a case requiring the trephine, without exfoliation being awaited, and this whether symptoms of pressure exist or not; and he gives three cases in support of this doctrine. (*De l'Opération du Trépan*, p. 23.) I have seen cases in which the patients recovered by the exfoliation of both tables; but some of them encountered so much danger, that I suspect their chance of recovery would have been increased by acting on the principle inculcated by M. Velpeau. Yet, where the symptoms are not urgent, I should recommend awaiting exfoliation. M. Velpeau is, perhaps, rather too zealous an advocate for this practice. (*De l'Opér. du Trépan*, p. 79.)

3. Fissures and Fractures of the Cranium without Depression.

Fractures of the cranium are divisible into "those in which the broken parts keep their proper level, or equality of surface, with the rest of the skull, and those in which they do not; or, in other words, fractures *without depression*, and fractures *with it*.

"These two distinctions are all which are really necessary to be made, and will be found to comprehend every violent division of the parts of the skull (not made by a cutting instrument), from the finest capillary fissure up to the most complicated fracture." (*Pott.*) In most instances, the fracture takes place in the upper part of the cranium; and it is also correctly noticed by Sir Benjamin Brodie, that fractures of its basis are always the consequence of very great violence, and recoveries from them comparatively rare. (*Med. Chir. Trans.* vol. xiv. p. 328.) The inner table of the skull, being more brittle than the outer one, is usually broken to a greater extent than the latter. In the situation of the frontal sinuses and parietal eminences, however, where the diploe is abundant, the outer table may be fractured without the inner one being at all implicated. (See *A. Velpeau, De l'Opér. du Trépan*, p. 27.) Sometimes the fracture does not occur at the point to which the violence has been directly applied, but elsewhere, as the effect of what the French term a *contre-coup*. Various explanations of the fact have been offered. Mr. Earle has never known it happen, except when the occiput seemed to have been forcibly impelled against the atlas. (*Sir B. Brodie, in Med. Chir. Trans.* vol. xiv. p. 329.) An ingenious attempt to account for the circumstance may be found in the writings of Sir C. Bell; though certain cases on record will not conform to any principles yet offered in explanation of them. M. Velpeau sets down counter-fissures as less dangerous than direct fractures, inasmuch as they are not exposed to the air, nor accompanied by any contusion of the pericranium, and the contiguous membranes of the brain suffer less; but he admits that they are usually combined with more violent concussion, a greater tendency to inflammation of the brain, and frequently with extravasation of blood, or, in a subsequent stage, with abscesses. (*De l'Opér. du Trépan*, p. 35.) According to my experience, counter-fissures are mostly fatal cases. The disjunction of the sutures is much more rare than fractures of the cranium, and can only happen in young subjects, in whom the sutures are not yet consolidated. They are accidents, implying the operation of great violence, and, in this point of view, may be viewed as dangerous. (*Sir B. Brodie, Op.* cit. vol. xiv. p. 332.)

No truth in surgery is now better understood and established, than that the bad symptoms, frequently accompanying a broken skull, are not produced by the breach made in the bone, nor indicate such breach to have been made. As Sir Astley Cooper remarks, the danger of fractures of the skull depends upon their being united with concussion or extravasation; there is also a remote danger from inflammation. (*Lectures, &c.* p. 289.) This was the doctrine so well explained by Pott, who observes: "The sickness, giddiness, vomiting, and loss of sense and motion, can only be the consequence of an affection of the brain, as the common sensorium. They may be produced by its having been violently shaken, by a derangement of its medullary structure, or by unnatural pressure made by a fluid extravasated on its surface, or within its ventricles; but never can be caused by the mere division of the bone (considered abstractedly); which division, in a simple fracture, can neither press on, nor derange, the structure of the parts within the cranium.

"The operation of the trepan is frequently performed in the case of simple fractures, and that very judiciously and properly; but it is not performed because the bone is broken or cracked. A mere fracture, or fissure of the skull can never require perforation, or that the dura mater under it be laid bare; the reason for doing this springs from other causes than the fracture, and those really independent of it: they spring from the nature of the mischief which the parts within the cranium have sustained, and not from the accidental division of the bone. From these arise the threatening symptoms; from these all the hazard; and from these, the necessity and vindication of performing the operation of the trepan.

"If a simple fracture of the cranium was unattended in present with any of the before-mentioned symptoms, and there was no reason for apprehending any other evil in future, that is, if the solution of continuity in the bone was the whole disease, it could not possibly indicate any other curative intention, but the general one in all fractures, viz. the union of the divided parts." (*Pott.*) Even a fracture of the basis of the skull, which is most frequently fatal, proves so, not because this part of the cranium is broken (the fracture itself being here not more dangerous than elsewhere), but "because it is almost invariably complicated with extensive injury of other and more important parts." (*Sir B. Brodie, in Med. Chir. Trans.* vol. xiv. p. 328.) The post mortem examinations, which I have attended, lead me to believe, that most of these cases are complicated with extravasation.

I could relate numerous examples to the point, if it were any longer necessary, in the present state of surgical knowledge, to cite facts, in proof of the important truth, that the mere undepressed fissure, or fracture of the skull itself, cannot be the source of the immediate bad symptoms, but that, in these cases, the whole of the sudden peril arises from the manner in which the brain and its membranes have been hurt by the same violence which caused the injury of the bone. Dr. John Thomson had opportunities of witnessing in the Netherlands several instances, which can leave no doubt upon the subject. "In some of the wounds (says he) in which the head had been struck obliquely by the sabre, portions of the cranium had been removed, without the brain appearing to have sustained much injury. In one case of this kind, where a considerable portion of the upper part of the occipital bone, *along with the dura mater*, had been removed, a tendency to protrusion of the brain took place during an attack of inflammation; a slight degree of stupor with loss of memory occurred; but, on the inflammatory state having been subdued, the brain sunk to its former level, the stupor went off, and the memory returned:" — and in another remarkable sabre-cut, more than an inch in breadth of the left lobe of the cerebellum was exposed, and *was seen pulsating for a period of eight weeks*, yet the injury was unaccompanied with any particular constitutional symptoms. (See *Obs. made in the Military Hospitals of Belgium*, p. 50, 51.)

In many cases of simple undepressed fractures of the cranium, it is true, that trephining is necessary; but, the reasons for the operation, in these instances, are, first, the immediate relief of present symptoms, arising from the pressure of extravasated fluid; and, secondly, the discharge of matter, formed between the skull and dura mater, in consequence of inflammation. If the edges of the fissure are widely apart, and blood is freely escaping from it, the application of the trephine should be deferred, provided the symptoms of compression were not very urgent. Such a fissure, be it recollected, however, is generally connected with a very extensive fracture, and, if there is extravasation, it is likely to be over a large surface; so that the trephine will probably be of no service. (See *M. Velpeau, De l'Opér. du Trépan*, p. 32.) The operation of trephining was sometimes recommended by Pott, as a *preventive* of ill consequences; a practice, however, which is now never adopted; and many writers of the highest reputation, especially Desault, Dease, John Bell, and Abernethy, have strongly remonstrated against it.

The latter remarks: "In the accounts which we have of the former practice in France, it is related, that surgeons made numerous perforations along the whole track of a fracture of the cranium; and, as far as I am able to judge, without any clear design. Mr. Pott also advises such an operation, with a view to prevent the inflammation and suppuration of the dura mater, which he so much apprehended. But many cases have occurred of late, where, even in fractures with depression, the patients have done well without an operation."

Mr. Abernethy next relates several cases of fracture of the cranium with depression, which terminated favourably, although no operation had been performed, and expresses his belief that these cases, as well as a great many others on record, prove, that at all events a slight degree of pressure may not derange the functions of the brain, for a limited time after its application, and in this circumstance probably never; for all those patients, whom he had an opportunity of knowing for any length of time after the accident, continued as well as if nothing of the kind had happened to them. In Hill's *Cases in Surgery*, two instances of this sort are related, and Mr. Hill knew both the patients for many years afterwards; yet no inconvenience arose. Indeed it is not easy to conceive that the pressure, which caused no ill effects at a time when the contents of the cranium filled its cavity completely, should afterwards prove injurious, when they have adapted themselves to its altered size and shape. Severe illness, it is true, often intervenes between the receipt of the injury and the time of the recovery; and many surgeons might be inclined to attribute this to pressure; but it equally occurs when the depressed portion is elevated. If a surgeon, prepossessed with the opinion, that elevation of the bone is necessary in every instance of depressed cranium, should have acted upon this opinion in several of the cases which Mr. Abernethy has related, and afterwards have employed proper evacuations, his patients would probably have had no bad symptoms, and he would naturally have attributed their well-doing to the mode of treatment which he had pursued: yet, these cases did equally well without an operation. (See *Abernethy's Surgical Works*, vol. ii. p. 4., &c. 8vo. Lond. 1811.)

Depressed fractures of the skull not being the immediate consideration, I need not expatiate upon them; but it seemed right to make the preceding remarks, in order to show how unnecessary it must be to trephine a patient, merely because there is a fracture of the cranium, and with a view of *preventing* bad consequences. Even when the fracture is depressed, it is not necessary, unless there are evident signs, that the degree of pressure, thus produced on the brain, is the cause of existing bad symptoms.

The inflammation and suppuration of the parts beneath the skull, which Mr. Pott wished so much to prevent by trephining early, do not arise from the occurrence of a breach in the cranium, but are the consequences of the same violence which was the occasion of the fracture. Hence, it is obvious, that removing a portion of the bone cannot in the least prevent the inflammation and suppuration, which must result from the external violence which was first applied to the head; but, on the contrary, such a removal, being an additional violence, must have a tendency to increase the inevitable inflammatory mischief.

From what has been said, it is not to be inferred, however, that trephining is never proper, when there is a simple undepressed fracture of the skull. Such injury may be joined with an extravasation of blood on the dura mater; or, it may be followed by the formation of matter between this membrane and the cranium; in both which circumstances the operation is essential to the preservation of the patient, immediately, but not before, the symptoms indicative of the existence of dangerous pressure on the brain begin to show themselves. (See TREPHINE.)

A fracture of the skull, unattended with urgent symptoms, and not brought into the surgeon's view by any accidental wound of the integuments, often remains for ever undiscovered; and as no benefit could arise from laying it bare by an incision, such practice should never be adopted. The surgeon ought only to be officious in this way when he can accomplish by it some better object than the mere gratification of his own curiosity. And as we shall find from the perusal of this article, and the one entitled *Trephine*, that in these cases, the removal of pressure off the surface of the brain is the only possible reason for ever perforating the cranium with this instrument; and, as dividing the scalp is only a useful measure, when it is preparatory to such operation; neither the one, nor the other, should ever be practised, unless there exist unequivocal symptoms, that there is a dangerous degree of pressure operating on the brain, and caused either by matter, extravasated blood, or a depressed portion of the skull. If any exceptions can be made to this observation, these are cases in which it is advisable to remove loose splinters and fragments of bone, or balls, plainly felt under the scalp, or examples of *punctured fracture*, as it is termed, where the inner table is sure to be splintered and more extensively broken than the outer, and inflammation and suppuration beneath the injured part of the bone be certain of ensuing, if this be not removed. (See *Liston's Elements*; and *Velpeau, De l'Opération du Trépan*, p. 42.) In all ordinary cases, the true mode of *preventing* the bad effects frequently following, but not arising from simple fractures of the skull, is not to trephine, but to put in practice all kinds of antiphlogistic means. For this purpose, let the patient be repeatedly and copiously bled, both from the arm and temporal arteries; apply cold lotions; let him be properly purged; give him antimonials; keep him on the lowest diet; let him remain in the most quiet situation possible; and if, notwithstanding such steps, the symptoms of inflammation of the brain continue to increase, let a large blister be applied to the scalp. If the scalp be wounded, it is to be healed as speedily as possible. Bloodletting and purgatives (as Sir Astley Cooper remarks) will sometimes remove the symptoms of concussion and extravasation, when they accompany the fracture, and a few hours will often show that the trephine, which was at first thought indispensable, is unnecessary. Irreparable mischief might arise from your making an incision, and converting a simple into a compound fracture. "If you act prudently (he adds), you will try bleeding and purgatives, before you operate; and the depletion will prove of the greatest possible advantage in preventing inflammation." (*Lectures*, vol. i. p. 299.) These are the cases, also, in which the topical application of cold water to the shaved and naked head, by means of cloths kept constantly wet, is an eligible, though, in this country, a much-neglected practice. Numerous instances, however, in favour of the method are recorded by the experienced Schmucker (*Chir. Wahrnehmungen*, b. i. Berlin, 1774); and the trials which I have seen made of it, give me a high opinion of its superior efficacy. When in spite of all these measures, matter forms under the cranium, attended with symptoms of pressure, a puffy tumour of the injured part of the scalp, or those changes of the wound, if there is one, which Mr. Pott has so excellently described; not a moment should be lost in delaying to perforate the bone with the trephine, and giving vent to the confined matter.

Fractures at the basis of the skull are extremely dangerous, because they are generally attended with extravasation, or followed by inflammation of the brain, in consequence of the violence of the injury. According to Sir Astley Cooper, they are produced by falls from a great height on the summit of the head. The whole weight of the body is received on the foramen magnum, and cuneiform process of the os occipitis, and, in many instances, the consequence is a transverse fracture through the foramen magnum, the cuneiform process, and part of the temporal bone. A discharge of blood into each meatus auditorius accompanies the accident. It is supposed also, that the deafness which sometimes remains during life, in rare instances of recovery, is the result of this kind of injury. (*Lectures, &c.* vol. i. p. 289.)

A fracture within the orbit may be occasioned by the forcible introduction of a stick, weapon, or pointed instrument, and is generally fatal, from the pressure and irritation of the depressed splinters of bone, and the simultaneous wound of the brain. The symptoms in the beginning, however, are frequently mild and deceitful, and it is not till inflammation and suppuration ensue, that the patient's condition is always such as to create immediate alarm. A case exemplifying this fact is reported by Sir A. Cooper. (Vol. cit. p. 295.) The same eminent surgeon mentions the occasional production of a circular fracture of the entire cranium, by a blow on the vertex; also the emphysema of the forehead, or the escape of the air, if there be a wound, caused when the nose is blown, in the case of a fracture extending into the frontal sinuses; and the complete detachment, sometimes met with, of the fragments, instead of their depression. His observations confirm the fact, that fractures of the skull, if unaccompanied with concussion or compression, become united like those of other bones; but he adds, that it is more slowly, and that where the interspace is wide, it will not be filled up with bony matter. (P. 297, 298.)

4. Fractures of the Cranium, with Depression,

Are sometimes attended with a moveable state of the fragments, and a crepitus; while, in other instances, the bottom of the depression is as unyielding as its margins. The projection of such a fracture inward, is also exceedingly variable; the bone may be more or less irregular, the dura mater and brain lacerated, or the membranes simply pushed inward. (See *Velpeau, De l'Oper. du Trépan*, p. 37.)

In simple fractures of the skull, or those in which the parts of the broken bone are not depressed from their situation, Mr. Pott remarks, that "the chirurgical intention, and requisite treatment, are the same in each, viz. to procure a discharge for any fluid which may be extravasated in present (*provided the pressure of such extravasation produces urgent symptoms, a condition which should here be added*), and to guard against the formation or confinement of matter." The prevention of suppuration will, as we have already remarked, be best accomplished, not by perforating the cranium, as Mr. Pott advised, but by copious bleeding, evacuations, cold washes to the head, blisters, and a rigorous antiphlogistic regimen. However, the confinement of matter, producing symptoms of pressure on the brain, certainly indicates the immediate use of the trephine.

"But," says the author, "in fractures attended with depression, there are other intentions. In these, the depressed parts are to be elevated; and such as are so separated as to be incapable of reunion, or of being brought to lie properly, and without pressing on the brain, are to be totally removed. These circumstances are peculiar to a depressed fracture; but, although they are peculiar, they must not be considered as sole, but as additional to those which have been mentioned at large under the head of simple fracture: commotion, extravasation, inflammation, suppuration, and every ill which can attend on or be found in the latter, are to be met with in the former, and will require the same method of treatment." That loose splintered pieces of the cranium, when quite detached, and already in view, in consequence of the scalp being wounded, ought to be taken away, no one will be inclined to question. That they ought also to be exposed by an incision, even when the scalp is unwounded, and then taken away, whenever they cause urgent symptoms of irritation or pressure, I believe will be universally allowed. But the reader will already understand, from what has been said in the preceding section, that several excellent surgeons do not coincide with Pott, in believing that every depressed fracture of the skull necessarily demands the application of the trephine.

"There certainly are," says Mr. Abernethy degrees of this injury, which it would be highly imprudent to treat in this manner. Whenever the patient retains his senses perfectly, I should think it improper to trephine him, unless symptoms arose that indicated the necessity of it." (P. 21.)

It is extraordinary and unaccountable, but it is not less true, that no calculation of the bad effects can be made by the degree in which a part of the skull is depressed. This is a fact which has been long known. It has also been particularly adverted to by an eminent modern writer. "Various instances also presented themselves, in which, though a considerable degree of compression must have been occasioned, sometimes by the depression of both tables, and at other times by the depression of the inner table only, of the skull, yet neither stupor, paralysis, nor loss of memory was produced. In one of these cases, the middle of the right parietal bone was fractured, and considerably depressed, by a ball, which was extracted on the twentieth day. In this case, neither stupor nor paralysis appeared. In another, a musket-ball had struck the right parietal bone, fractured it, and was flattened, and lodged between the tables of the skull. The inner table was much depressed, yet no bad symptoms supervened." (See *Thomson's Obs. made in the Military Hospitals in Belgium*, p. 59, 60.) The same author also saw a singular case, in which a ball, entering behind the right temple, and passing backwards and downwards, had fractured the bones in its passage, and lodged on the surface of the brain, over the tentorium, from which place it was extracted on the seventeenth day after the injury. No bad symptom had manifested itself previously to the operation; and the man recovered, under the strictest antiphlogistic regimen, with little or no constitutional derangement. Dr. Hennen has recorded two cases, fully proving the correctness of Mr. Abernethy's opinions, about the impropriety of using the trephine in cases of depression unattended with urgent symptoms: in one of these instances, the upper and posterior angle of the parietal, which had been struck by a musket-ball, was depressed exactly *an inch and a quarter from the surface of the scalp, yet no bad symptoms followed*, and with the aid of bleeding and other antiphlogistic remedies, the soldier recovered perfectly in a few weeks. "In a similar case, where the man survived thirteen years, with no other inconvenience than occasional determination of blood to the head on hard drinking, *a funnel-like depression to the depth of an inch and a half* was formed in the vertex." (See *Hennen's Military Surgery*, p. 287. ed. 2.)

If then the violence of the symptoms is not always in proportion to the compression, but is sometimes considerable when the pressure is slight, every surgeon cannot be too fully impressed with the following truth, that *existing symptoms of dangerous pressure on the brain*, which symptoms will be presently related, *can alone form a true reason for perforating the cranium.*

Although the doctrines of Sir Astley Cooper, generally speaking, coincide very much with the preceding maxim, which I regard as a very important one, there is an exception to it in his advice, in relation to compound fractures of the skull, as will be understood from the following passage. "The old practice used to be, the moment an injury of the brain was suspected, and the least depression of the bone appeared, to make an incision into the scalp. This is putting the patient to considerable hazard; for the simple fracture would, by the incision, be rendered compound. In simple fracture, then, when it is attended with symptoms of injury of the brain, deplete before you trephine; and when it is unattended with such symptoms, deplete merely, and do not divide the scalp, &c. If the fracture be compound, the treatment must be very different; because a compound fracture is very generally followed by inflammation of the brain; and it will be of little use to trephine, when inflammation is once produced. If the inflammation come on, the patient will generally die, whether you trephine or not;" and, it is added, that the operation will even be likely to increase the inflammation, which has been excited by a depressed portion of the skull. "The rule (says Sir Astley) which I always follow, is this: when I am called to a compound fracture, with depression, which is exposed to view, whether symptoms of injured brain exist or not, I generally use an elevator, and very rarely the trephine. I put the elevator under the bone, raise it, and, if it has been comminuted, remove the small portions of bone." (*Lectures, &c.*, vol. i. p. 304. 308.) Of the propriety of using the elevator in such cases, and also of taking away loose fragments, there cannot be a doubt; but many surgeons object (and I confess myself one of the number) to saw out a portion of the skull while the patient is free from urgent symptoms. I believe, also, that the inflammation, when it does arise, is mostly the effect of the violence itself, not of the depression of the bone, and, therefore, more likely to be increased than prevented by the application of the trephine. I think a better reason for elevating the bone, when it is exposed, and there are no bad symptoms, is the fact, that many patients, after their recovery from the imminent danger of the accident, become subject, whenever the circulation is hurried, to insanity, or epilepsy, or remain in a state of hebetude, with dilated pupils, and more or less impairment of some of the external senses, as the eyesight, &c., (See *Case by H. Larrey, in Hist. Chir. du Siége de la Citadelle d'Anvers*. p. 114.) Yet, here it is to be considered, that it may be quite time enough to trephine when such ills follow the continuance of the depression, and that, perhaps, the operation would then be in itself less dangerous, inasmuch as the tendency to inflammation, arising from the first violence, must now have subsided. Much would depend, however, upon the frequency and severity of the fits, and the degree of annoyance and suffering; for as M. H. Larrey well observes, the result of an operation would be doubtful, and it might even prove fatal. (*Op.* cit. p. 116.)

The view of this part of the subject, taken by M. Velpeau, does not exactly coincide with that entertained by Abernethy. "The cases (says he) of recovery, notwithstanding a depression to the depth of an inch, or an inch and a half, as recorded by numerous former observers, by no means prove, that in such examples trepanning is never useful. The same remark applies to the cases brought forward in modern times by Dorsey, Dupuytren, Paillard, Graefe, &c. These instances must all, or nearly all, have been fixed depressions, without any great inequalities internally, or manifest laceration of textures. Most of them had given rise to but slight symptoms of compression; and many of them to none at all. The case of a rich banker mentioned by Dupuytren, and who is still living with the bone depressed, although the injury took place many years ago, forms a kind of exception.

I know (observes M. Velpeau) that it is not the only one; but these are rare cases, on which it would be dangerous to lay a foundation. For one patient thus saved, ten would perish who might be preserved. I saw a woman who had a depression on the frontal bone half an inch deep, and whom I deemed it improper to operate upon, because she had no alarming symptoms. Yet at the end of six weeks, she died of inflammation and suppuration of the anterior part of the brain. Would this have happened had she been trepanned?" (*De l'Opér. du Trépan*, p. 57.)

I believe few surgeons in London would have any difficulty in replying, that if the operation had been performed the result might, or might not, have been the same. It seems to me, also, that when signs of suppuration under the cranium first presented themselves, the operation might have been indicated, though not so in an earlier stage; but, without being in possession of all the particulars of the case, I offer this remark without any intention of being critical.

M. Velpeau is not on the whole an over zealous advocate for the operation; and some of his advice approximates very much to that delivered by Sir Astley Cooper, with a modification, depending upon whether the depression is immoveable and fixed. If it be of this kind, without manifest compression, he recommends delay, and antiphlogistic treatment. But when there is a wound, with denudation to the bottom of it, the operation seems to him called for, even though urgent or unequivocal symptoms of compression may be absent. He would not trepan, however, if the depression were broad, and of no great depth; if the intellects were uninterrupted, and there were no marks of paralysis. M. Velpeau regards a depression with mobility of the bone as far more dangerous. An effusion of blood, first, and pus afterwards, he sets down as frequent consequences of it; and the case is almost sure to prove fatal, unless the trepan be employed. (*Op.* cit. 58.) A moveable depressed fragment, I may observe, may often be removed with the forceps, without any occasion to perforate the cranium with the trephine, or trepan; and if not removeable in this simple manner, may frequently be taken away by dividing a small portion of the bone with one of Hey's saws. (See Trephine.)

M. Velpeau adverts to one species of depression, in which no good is derived from the trepan, namely, that in which the fracture is usually extensive, and the edges of the fragments overlap one another, in consequence of a violent concussion of the skull. Here, says he, the degree of crushing, contusion, and extravasation at different points, make the patient's recovery almost impossible.

In another place, M. Velpeau points out the practical importance of studying the differences in the symptoms of compression according as they depend upon a depression of bone, either simple or comminuted, a foreign body, an extravasation of blood, or an effusion of pus. A simple depressed fracture he sets down as the most favourable of these cases; for if the operation is not done, the brain in the end frequently becomes habituated to the pressure, and resumes its functions. If no extravasation take place, the pressure arising from a depressed fracture is really less than might at first be imagined. If the operation be decided upon, it presents the greatest chances of success, provided the compressing cause has not seriously wounded the brain. The rule which M. Velpeau here lays down, is, that in cases of depression, if the symptoms are not urgent, or begin to abate after 24 hours, the trepan may be dispensed with; but if they are at all intense, or make progress, the operation is strictly required. (*De l'Opér. du Trépan*, p. 120.)

In children, a portion of the skull is sometimes depressed, or indented by a blow, but in a few days regains its natural level, without the aid of the surgeon. In such examples, it is conceived by Sir Benjamin Brodie, that the earthy part of the bone gives way, while the animal part remains entire, so that there is not an actual solution of continuity; and he supposes that the restoration of the bone to its proper level is brought about by the constant pulsations of the brain against its inner surface. (See *Med. Chir. Trans.* vol. xiv. p. 332.)

M. Velpeau denies the possibility of indentations without fracture. (*Op.* cit. p. 36.)

Sometimes a considerable depression of the bone arises from the external table being driven into the diploe, while the inner table is entire. To trephine, therefore, merely because there is a depression of the bone, would be completely erroneous, and the only safe principle is that which I have just now specified. The depression of the outer table in the foregoing manner I have never seen myself, except over the frontal sinus. Sir Astley Cooper, however, mentions it as a frequent occurrence; but that it is confined to persons of middle age, as in very young and very old persons the skull is thin and without diploe. (*Lectures*, vol. i. p. 302.) Another sort of depression, I believe, is more frequent; at least, I have seen several examples of the case: it consists in a fracture and depression of the internal table, while the external one continues unbroken. A case of this kind, attended with urgent symptoms of compression, I trephined at Brussels: after the battle of Waterloo, a large splinter of the inner table was driven more than an inch into the brain, and, on its extraction, the patient's senses and power of voluntary motion instantly returned. Part of the skull to which the trephine was applied, of course, did not indicate externally any depression, and it was selected because the appearance of the scalp showed that there the external violence had operated. I rather expected to find extravasated blood, than a depression of the inner table of the skull. (See also *Saucerotte, in Mém. pour le Prix de l'Acad. de Chir.* t. iv. ed. 1819, p. 322. *Bilguer*, two examples as quoted by *M. Velpeau, De l'Opér. du Trépan*, p. 29. *Hennen's Military Surgery*, p. 323. ed. 2.; and *Sir B. C. Brodie*, in *Med. Chir. Trans.* vol. xvi. p. 331.)

In military surgery, particular cases present themselves, which scarcely admit of being comprehended within the tenor of any general rules and principles. Thus it sometimes happens, that a ball breaks the os frontis, and the whole or a part of it lodges in the frontal sinus, with or without fracture of the inner boundary of this cavity. In cases of this description, Baron Larrey recommends exposing the course of the fracture by a free incision, and the use of the trephine for the removal of the extraneous body. When the inner side of the sinus was found broken and depressed, he next perforated that part of the cavity with a small conical trephine, took away such pieces of bone as required removal, and let out any extravasated blood. Sometimes, however, the front of the sinus is so splintered, that the fragments, when taken away with the forceps, leave the cavity sufficiently opened, not only for the extraction of the ball, but for the application of the trephine to the inside of the sinus, as we find exemplified in one of the two cases of this nature, which Larrey met with in the Egyptian campaign. (*Mém. de Chir. Militaire*, t. ii. p. 138.) After the battle of Witepsk, in 1812, he was called to two Russian soldiers, whose cases were remarkable; one of them had been struck above the right eyebrow, with a grape-shot, which after breaking and penetrating the frontal bone, entered the cavity of the cranium, so as to lodge upon the anterior right lobe of the brain, and the orbitar process and internal crista of the os frontis. Notwithstanding the large size of the ball, little of it could be seen externally, and the aperture through which it had passed was not more than three or four lines broad; every attempt to extract it, therefore, was in vain. The patient experienced a painful sense of oppression and weight in the head, and, whenever he inclined it backward, was seized with syncope. He kept himself constantly in a sitting posture, with his head on his knees. Larrey adds, that every symptom of compression of the brain also prevailed, though this account is rather difficult to comprehend, considering that the patient could sit up, and choose his posture. As for any description given by himself of his sufferings, that is another circumstance, on which I should not be inclined to dwell, because in all probability the baron was not able to converse in the Russian language, and the inferences respecting the man's feelings were made in some other way. But whatever might be the real state of the symptoms (and in a case of this kind a correct account of them would have been interesting), the ball was plainly ascertained, by means of a probe, to be of iron, and of much larger diameter than the opening through which it had entered; and that, for the purpose of extracting it, the application of the trepan was urgently necessary. The fracture was fairly brought into view by suitable incisions; three perforations, were made with a small trephine at its upper part, and, after the removal of the angles of the bone between these perforations the ball, which weighed seven French ounces, was readily extracted with the aid of a strong pair of forceps, and an elevator. A considerable quantity of coagulated blood was also removed, under which the brain was found with a depression three or four lines deep. As soon as some splinters of the bone had been taken away the part was dressed with a bit of fine linen dipped in warm wine, over which were placed charpie, several compresses, and a bandage. With respect to the application of warm wine, and other stimulants, to the surface of the brain, in wounds exposing or interesting that organ, it seems to be an invariable practice with Larrey, as well as Schmucker and the older surgeons. On what principle the custom is still kept up, and whether it is truly right and useful, are questions which may be rationally put. In whatever way experience may hereafter decide these matters, suffice it to add, that the patient was relieved by the treatment, and fell into a quiet sleep for two hours; but in the evening he became feverish, and the wound acutely painful. A copious quantity of blood was then taken from the vena saphena (and why bleeding was not practised at first, seems extraordinary). The dressings, which, according to my ideas, were highly objectionable, were removed, and a large emollient poultice applied. Cooling beverages, containing a small quantity of tartarised antimony, and antispasmodic anodyne medicines, were prescribed. The following day, the patient's state appeared satisfactory, without the slightest disturbance of the senses, and, in due time, he perfectly recovered.

The other soldier had been wounded in the left temple, with a leaden ball, five days before Larrey saw him. One half of the ball had gone into the cranium, through a very narrow breach; the other had burrowed under the temporal muscle, and lodged near the mastoid process. The right side of the body was paralytic, the senses were annihilated, and the man was in a state of incessant agitation. After dilating the wound in the temple, and exposing the fracture, Larrey discovered the track of the piece of lead, which had gone towards the mastoid process, and which he immediately extracted by a counter opening. At the lower part of the temporal wound, he applied a trepan, very near the spot where the other portion of the ball was lodged. This, with some fragments of the bone, and a quantity of extravasated blood, was easily extracted. The patient, however, was not saved; the operation having been done too late.

In another case, one of the Imperial Guards, wounded at the battle of the Moskowa, died with symptoms of compression, and, after death, a quarter of a bullet and a fragment of bone were found under the skull, attended with an ulcerated or wounded state of the adjacent portion of the brain. Larrey expresses his opinion, that this soldier would have had a chance of being saved, had the trepan been used. (See *Mém. de Chir. Mil.* t. iv. p. 183, &c.) The practice of trephining for the removal of balls, situated near a fracture of the skull, within this bony cavity, or lodged amongst the fragments, or between the two tables forced asunder (see *Engel's case, in Vermischte Chir. Schriften von J. L. Schmucker*, b. i. p. 242.), is not peculiar to Larrey, for it has been done by many other surgeons (see *Schmucker's Wahrnehmungen*, b. i. p. 298.); but I do not know that he has been anticipated in his bold practice of making a counter-opening in the skull, when the ball is lodged at such a distance from the fracture, that it cannot be extracted through any perforation made in the vicinity of the original injury; for it is a principle which he ventures to lay down, that *when a ball has entered the cranium, without quitting the roof of this cavity, the case is one requiring the application of the trepan.* (*Mém. de Chir. Mil.* t. iv. p. 180.) In the 2d vol. of this work (p. 139.), the reader will find the account of a soldier, who was struck on the middle of the forehead with a ball which penetrated the os frontis, and then passed obliquely backwards, between the skull and the dura mater, in the course of the longitudinal sinus, as far as the lambdoidal suture, where it stopped. Larrey traced the situation of the ball, by the introduction of an elastic gum catheter into the opening; and measuring the distance between the fracture and the place where he felt the ball, he cut down upon that part of the skull, beneath which he concluded that the ball was lodged. The bone was then perforated with a large trepan; *a good deal of pus was discharged:* the ball was extracted, and the patient recovered. One thing here merits the attention of surgeons: Larrey tells us that a good deal of pus issued as soon as an opening had been made in the skull: there must then have been suppuration under the bone, and inflammation and detachment of the dura mater; circumstances always indicated, according to Pott, by a corresponding separation of the pericranium, and a puffy tumour of the scalp. Did these symptoms take place in the foregoing case, so as to be of any assistance to Larrey, in judging of the place where the ball was lodged? and, has the mention of them been omitted only by accident? or, are we to infer, that suppuration may happen between the cranium and dura mater, without any detachment of the pericranium and puffy tumour of the scalp; a thing which Bichat asserts is proved by daily experience in the Hôtel-Dieu, at Paris? (See *Œuvres Chir. de Desault*, t. ii. p. 29.) Larrey, in his 3d vol. (p. 82.), gives us another case, in which a ball pierced the left parietal bone, and lodged near the lambdoidal suture. Its situation was detected with the aid of an elastic gum catheter, and partly in consequence of there being a slight ecchymosis over the part. Here a crucial incision was made through the scalp, and a small fissure discovered. As the symptoms of compression increased, the trepan was applied, so as to include the fissure. A half of the ball, flattened, was found directly under the perforation, and a good deal of blood was voided from the two openings in the cranium. For a fortnight, the case went on favourably; but the patient was then attacked with what Larrey terms hospital fever, but which, in all probability, was inflammation and suppuration of the membranes of the brain, and died.

The records of surgery furnish numerous instances, in which the patients lived a considerable time with balls lodged in the cavity of the cranium. Thus, one is related by Paroisse, where the patient soon recovered his senses after the injury, and, at the end of six months, felt no inconvenience, except a difficulty of opening the mouth. (*Opuscules de Chir.* Obs. i. 8vo. Paris, 1806.) Ramdohr published another case, where a soldier was shot through the frontal sinus, and the ball was found after death in the medullary substance of the left hemisphere of the brain, half an inch above the ventricle; yet this patient lived four months after the injury, and soon recovered his senses after its occurrence. For a considerable part of this time, he was also free from any bad symptoms. At last, he was affected with a kind of stupor, and an inability to open his left eye, and fell into a lethargic and convulsed state. (*Schmucker, Vermischte Chir. Schriften*, b. i. p. 277.) A French soldier, at the battle of Waterloo, was wounded with a musket-ball, which entered at the anterior portion of the squamous suture, lodged in the substance of the brain, and on the fifth day, after an enlargement of the wound, and the removal of several fragments of bone, was extracted from the posterior lobe of the right hemisphere of the brain, where it was found resting on the tentorium. Yet, during the several previous days, the man, with the exception of a slight headach, and partial deafness of the right ear, seemed to enjoy perfect health. The case ended well. (See *Hennen's Mil. Surg.* p. 289. ed. 2.) M. Velpeau cites a case, where several small shots lodged for many years on the dura mater, and were the cause of epileptic attacks. (*De l'Opér. du Trépan*, p. 44.) He saw a soldier at the *Invalides*, with a ball, that had remained fixed for many years in the opening, which it had produced in the skull, the man having refused to permit its extraction to be attempted: from the account, however, I infer, that it lay partly in the frontal sinus, and that the inner table was not injured. The same surgeon also quotes a case from Schmucker (*Bibl. du Nord*, t. i.), where a wounded person remained senseless for six days, with a piece of the barrel of a gun within the skull: four perforations were made with the trepan, and a recovery took place. In the *Méd. Chir. Trans.* are the particulars of a case, in which the linch-pin of a gun was driven into the os frontis, and penetrated the brain, so as to be concealed, and its presence not suspected, till the twenty-seventh day after the accident, when it was detected and taken out. The boy walked some distance directly after the accident, and then fell down senseless and convulsed. By means of antiphlogistic treatment, he regained his mental faculties the next day, and finally recovered, with the exception of amaurosis of one eye. Notwithstanding the instances on record of balls and other foreign bodies having lodged in the brain without proving fatal (see *Ramdohr, Op.* cit. p. 81., and *La Martinière, as referred to by Velpeau*), the rule in surgery is always to extract them when practicable. In a case, mentioned by Quesnay (p. 23.), the patient, who was supposed to be entirely out of danger, died a year afterwards, and the ball was found in the brain at the depth of two inches. The example, published by Anel (*Acad. de Chir.* t. i. p. 236.), terminated in the patient's sudden death, and the ball was found on the pineal gland. Many other interesting observations on this subject have been collected by M. Velpeau. (*De l'Opér. du Trépan*, p. 48.) All foreign bodies, occasioning irritation or laceration of the brain, seem to M. Velpeau formally to require the perforation of the cranium; but the chances of a favourable result are less than in a simple depression of the bone, on account of the risk of inflammation of the brain being greater. (*Op.* cit. p. 122.)

Remarkable instances of the duration of life, and even of the absence of very serious symptoms, after great and serious wounds of the brain, and the lodgment of balls, are recorded in the Essay of M. Quesnay (*Mém. de l'Acad. de Chir.* vol. i. 4to.) Professor Sewall, of Washington, has reported two cases of fracture of the cranium, *with loss of a portion of the substance of the brain.* In one of them, the injury was inflicted with a spade, which penetrated through the dura mater and into the medullary substance of the brain. The antiphlogistic treatment was relied upon from the commencement, and during the suppuration which followed; some of the brain itself protruded and sloughed away, and subsequently portions of it were removed with a spatula. Nevertheless, in six weeks, the patient completely recovered. (See *Amer. Journ. of the Med. and Phys. Sciences*, No. iii.; and *Reese's Amer. ed. of this Dict.*) Twenty-two French soldiers, whose vertices, with more or less of the brain, had been cut off by sabre-strokes, had, at first, not a single bad symptom, and all performed a journey of thirty leagues after being wounded, and one half of this distance on foot. Ten of them died. (See *Paroisse, Opuscules de Chir.* p. 41. &c.) Several cases, exemplifying the absence of bad symptoms in the first stage of a wound of the brain, and yet terminating fatally, I have seen in the army, as well as at St. Bartholomew's and University College Hospitals. A case is recorded by Fardeau (*Soc. d'Emul.* t. viii. p. 399.), of a bayonet penetrating one temple and coming out below the cheek of the opposite side: the efforts of a strong man were required to get it out again: the patient recovered. Whether the brain was pierced in this example may, I think, admit of doubt.

5. Extravasation under the Cranium, Symptoms of Pressure on the Brain, etc.

Mr. Pott remarks, "the shock, which the head sometimes receives by falls from on high, or by strokes from ponderous bodies, does not unfrequently cause a breach in some of the vessels, either of the brain or its meninges; and thereby occasions extravasation of the fluid which should circulate through them. This extravasation may be the only complaint produced by the accident; or it may be joined with, or added to, a fracture of the skull. But, this is not all; for it may be produced not only when the cranium is unhurt by the blow, but even when no violence of any kind has been offered to, or received by, the head."

The effused blood may lie between the cranium and dura mater; between the latter membrane and the arachnoides; on the surface of the pia mater; or under this membrane, on the surface, in the substance, or cavities of the brain. The first species of extravasation, which is observed to be always more or less circumscribed, may occur at any part of the skull, but, when situated at its base, is generally fatal. In the second, which is the most common species of extravasation within the dura mater (see *Brodie, in Med. Chir. Trans.* vol. xiv. p. 333.), the blood is widely scattered about between the dura mater and arachnoides, and on this account, unless its quantity be very considerable, it does not cause any great degree of pressure. In the third example, if the blood be situated in the convolutions, it is also widely diffused; but if it be within the substance or ventricles of the brain, which is rare (*Brodie*, vol. cit.), it is circumscribed. (*Œuvres Chir. de Desault*, t. ii. p. 23.) Sometimes, in cases of great violence, the blood is found at the same time in all these different parts.

According to Sir Benjamin Brodie's experience, which confirms the observations of Mr. Abernethy, there is never such hæmorrhage from a rupture of the blood-vessels, by which the dura mater is connected to the bone, as will produce dangerous pressure on the brain, except when the middle meningeal artery has been lacerated, from which vessel the bleeding is sometimes very copious. Sir Benjamin Brodie has never seen this artery lacerated, except in the combination with a fracture running across the bony canal in which it is situated; but he adverts to other cases, recorded by Latta and Abernethy, in which no such fracture accompanied the rupture of the vessel. (See *Med. Chir. Trans.* vol. xiv. p. 333.)

Another observation, made by Sir Benjamin Brodie, is, that large extravasations are sometimes found upon the upper surface of the brain, but more frequently at its basis, where they are usually the consequence of a rupture of the substance of the brain. The same surgeon has never seen an instance, in which the blood from a wounded sinus, collected between the dura mater and the skull, or between that membrane and the brain, was in sufficient quantity to interfere with the functions of the latter organ.

When blood is extravasated beneath the skull, the violence, which produces the rupture of the vessel, usually stuns the patient, from which state, provided the quantity and pressure of the blood, and the force of the concussion be not too great, he gradually recovers, and regains his senses. If the first extravasation be trivial, the patient, after regaining his senses, may only feel a little drowsiness, and go to bed. The bleeding from the ruptured vessel continuing, and the pressure on the brain increasing, he becomes more and more insensible, and begins to breathe in a slow, interrupted, stertorous manner. In cases of compression, whether from blood or a depressed portion of the skull, there is a general insensibility; the eyes are half open; the pupils dilated, and motionless, even before the vivid light of a candle; the retina is insensible; the limbs relaxed; the breathing stertorous; the pulse slow, and, according to Mr. Abernethy, less subject to intermission than in cases of concussion. The absence of stertor, however, as this gentleman admits, must not be relied upon as a proof of there being no compression; for, Morgagni relates dissections of apoplectic persons, in whom the effusion was considerable, yet no stertor had occurred.

In a case of wound of the posterior part of the skull, with depression, seen by Dr. J. Thomson, the pulse at one time sunk as low as 36 strokes in a minute. However, he is at variance with Mr. Abernethy upon one point, by stating, that irregularity of the pulse is a frequent attendant upon compressed brain. (*Report of Obs. &c.* p. 54, 55.)

Sir Benjamin Brodie does not give any positive opinion on the statement made by Mr. Abernethy, that intermission of the pulse is less frequent in compression than concussion; but he expresses his belief, that pressure on the brain for the most part affects the action of the heart; *not by producing actual interruption, but by causing its contractions to be either less frequent, or less forcible, than natural.* (*Med. Chir. Trans.* vol. xiv. p. 355.) In the cases referred to in Dr. Thomson's report, convulsions sometimes arose from the pressure of portions of the skull, forced inwards upon the brain. This is a very dangerous symptom; but Dr. Thomson saw it cease in a few examples, after the depressed piece of bone had been elevated, and the antiphlogistic regimen adopted. (p. 60.) Convulsions, I am disposed to regard, with Bichat, rather as a symptom of injury of the brain, than of compression. (*Œuvres Chir. de Desault*, t. ii. p. 27.)

Sir Benjamin Brodie, seemingly unaware of the corresponding remark published in the foregoing work, considers it questionable, whether convulsive twitches of the muscles ought to be regarded as the consequence of simple pressure on the brain. We find them occur, says he, in cases of punctured and wounded brain, where there is no pressure; and whenever he has noticed them, as attendant on depression of the skull, or extravasated blood, and has afterwards had the opportunity of ascertaining the exact nature of the injury, the *pressure has always been found to be complicated with wound, or laceration, of the substance of the brain.* The convulsive twitches to which Sir Benjamin Brodie alludes, he particularly describes as slight and partial, and different from the more violent and general convulsions. (See *Med. Chir. Trans.* vol. xiv. p. 352.)

Indeed, the difficulty of the diagnosis of many cases may be well conceived by what Dr. Hennen remarked, in his practice; viz. that, in some instances, the pupils were contracted, in others dilated, where the injury was nearly of a similar nature and degree; while, sometimes, in the same patient, one pupil was dilated, and the other much contracted. He saw, also, paralysis occur on one side, and convulsions on the other, when the blow had been on the forehead, and the same when it had been on the occiput. (*Op.* cit. p. 300, 301.)

Sir Benjamin Brodie has seen the pupils dilate with the absence, and contract with the presence, of light, although the patient lay in a state of complete insensibility, and did not seem to be at all conscious of the impressions made on the retina. He admits, however, that this is a rare occurrence, and that, when the other symptoms of pressure are present, the *pupils are generally insensible and motionless, and mostly dilated*, though sometimes contracted. Every surgeon of experience must be aware of another circumstance mentioned by the same surgeon; namely, that it is not uncommon for the pupils to remain for a time in a state of dilatation, then to become suddenly contracted, and, after remaining so for a longer or shorter time, to become again dilated; these changes taking place independently of light and darkness. When the pupils have been dilated, Sir Benjamin Brodie has frequently known them to become contracted after the abstraction of blood; the dilatation returning as soon as the immediate effect of the bloodletting had ceased. He adverts to a curious case, reported by Dr. Hennen, in which blood was extravasated between the membranes of the brain, and the pupils sometimes dilated in an increased light, and contracted in a diminution of it. (See *Med. Chir. Trans.* vol. xiv. p. 352.) Another observation, made by Sir Benjamin Brodie, is an occasional insensibility of one iris, dilatation of the pupil, and a ptosis, continuing after the subsidence of the general insensibility of the body, and even unattended with loss of vision. (Vol. cit. p. 354.)

The patient is hardly ever sick, when the pressure on the brain, and the general insensibility, are considerable; for the very action of vomiting betrays sensibility in the stomach and œsophagus. The truth of this statement, which agrees with Mr. Abernethy's experience, is strikingly confirmed by an observation made by Sir Benjamin Brodie; namely, that when he has had occasion to apply the trephine on account of a fracture and depression, and no sickness existed previously, he has sometimes known the patient become sick, and vomit immediately the depressed bone had been elevated. (See *Med. Chir. Trans.* vol. xiv. p. 356.) These symptoms are not peculiar to pressure from blood, but arise also from that of many depressed fractures of the skull, and of suppuration under this part. They are all attributable to the unnatural pressure made on the brain and nerves, and have too often been mistaken as indications of an injury, which, considered abstractedly, can never cause them.— I allude to a simple undepressed fracture of the cranium, which may be accompanied with them, but cannot cause them.—They differ in degree, according to the quantity, kind, and situation of the pressing fluid. The hemorrhage from the nose and ears, which often follows violence applied to the head, is generally conceived to lead to no particular or useful inference; we cannot even calculate, by this sign, that the force has exceeded a certain degree; for such bleedings take place from much slighter causes in some persons than others.

Sir Benjamin Brodie's observations on this point merit attention:—" There is often a considerable effusion of blood from the ear, especially in cases of fracture of the basis of the cranium. This may, as far as I know, sometimes arise from other sources; but it seems probable, that it must in most instances arise from the laceration of the lateral sinus, where it extends downwards behind the petrous process of the temporal bone, and the external meatus; and, in one instance, I ascertained it to have been so by the examination of the body after death. In another case, which fell under my observation, there was hemorrhage both from the ear and the nostrils. The patient, a boy, died shortly after the accident; and it was found, on dissection, that there was a fracture of the base of the cranium, with laceration of the cavernous sinus, and that the hemorrhage had taken place from this sinus." (See *Med. Chir. Trans.* vol. xiv. p. 334.) According to my experience, bleedings from the ear and nose, from injuries of the head, are particularly frequent in children, and often manifestly consist of arterial blood.

Paralysis is a symptom which generally attends hurtful pressure on the brain. The particular circumstances, however, which determine its degree, extent, and situation, are not well understood. " In some instances of paralysis from sabre-wounds, as well as in those made by gunshot (says Dr. J. Thomson), paralysis was confined to the upper, and in others to the lower, extremity. *In every instance, in which it distinctly appeared, that the injury existed on one side of the head, the paralysis uniformly manifested itself upon the other;* but we were unable to perceive any other fixed relation between the part of the brain, which had been injured, and the part of the body affected with palsy. A wound of the right parietal bone by a musket-ball was followed by palsy of the left arm and leg. In another case, a wound, penetrating the upper part of the right parietal bone, was accompanied with a slight paralytic affection of the left side of the mouth, and complete palsy of the left leg. In a third case, a sabre-wound of the same bone, followed by extensive exfoliations, gave rise to a complete palsy of the left side." (*Obs. in the Military Hospitals of Belgium,* p. 52, 53.)

When the destruction of sensibility is complete, the voluntary muscles are entirely paralysed. The patient lies motionless in any position in which he happens to be placed. The bladder, incapable of contraction, becomes preternaturally distended with urine; and the relaxation of the sphincter ani allows the involuntary discharge of feces from the rectum. Afterwards the muscles of respiration become affected also; the patient breathes with stertor, as in a most profound sleep; and the diaphragm contracts at longer and longer intervals, until respiration altogether ceases. It is this paralysis of the muscles of respiration, which, in ordinary cases of presssure on the brain, is the immediate cause of death. When the loss of sense is imperfect, there are often no marks of paralysis whatever. At other times, there is a hemiplegia, which, however, is much more rarely the consequence of accidental violence, than of apoplexy. Sir Benjamin Brodie conceives that this difference is referrible to the different situation of the pressure. In apoplexy, the extravasation is mostly situated in one of the ventricles, or in the substance of the brain; but, after a blow on the head, the cause of pressure commonly operates upon the surface. (*Med. Chir. Trans.* vol. xiv. p. 349, 350.)

With respect to paralysis, it is unquestionably one of the common symptoms of pressure on the brain; but, according to Bichat, it may also be caused by concussion; and we know, that it may arise in cases of inflammation and suppuration within the skull. The above statement, respecting the paralysis being always on the side of the body opposite that on which the brain is compressed, agrees with what is generally remarked by other surgical writers. (See *Larrey's Mém. de Chir. Mil.* t. iv p. 180.; *Hennen's Principles*, p. 301. ed. 2. &c.) Yet, at the Hôtel-Dieu, at Paris, extravasation has very often been noticed both on the side affected with paralysis, and on the opposite one; or else the blood was generally diffused, while the paralysis was local. (*Œuvres Chir. de Desault*, t. ii. p. 27.)

The preceding symptoms only inform us, that the brain is suffering compression; and leave us quite in the dark, respecting several other very important circumstances. "We not only have no *certain infallible* rule, whereby to distinguish what the pressing fluid is, or where it is situated, but we are, in many instances, absolutely incapable of knowing whether the symptoms be occasioned by any fluid at all; *for a fragment of bone broken off from the internal table of the cranium, and making an equal degree of pressure, will produce exactly the same complaints.* (Pott.) In detailing the symptoms of pressure from blood, I took particular notice of the patient being at first generally stunned by the blow, of his gradually regaining his senses, and of his afterwards relapsing into a state of insensibility again. *The interval of sense*, which thus occurs, was pointed out by Petit and Le Dran as a circumstance of the greatest consequence in elucidation of the nature of the case. It is still considered so by every surgeon of judgment and experience.

"The loss of sense, which immediately follows the violence, say they, is most probably owing to a commotion; but that which comes on after an interval of time has passed, is most probably caused by extravasation.

"This distinction is certainly just and good, as far as it will go. That degree of abolition or diminution of sense, which immediately attends or follows the blow or fall, and goes off again without the assistance of art, is in all probability occasioned by the sudden shake or temporary derangement of the contents of the head: and the same kind of symptoms recurring again some time after they had ceased, or not coming on until some time has passed from the receipt of the violence, do most probably proceed from the breach of a vessel within or upon the brain. But, unluckily, we have it not very often in our power to make this exact distinction. An extravasation is often made so immediately, and so largely, at the instant of the accident, that all sense and motion are instantaneously lost, and never again return. And it also sometimes happens, that although an extravasation may possibly not have been made at the moment of the accident, and the first complaints may have been owing to commotion merely, yet a quantity of fluid having been shed from its proper vessels very soon after the accident, and producing its proper symptoms, before those caused by the commotion have had time to go off, the similarity of the effects of each of these different causes is such, as to deprive us of all power of distinguishing between the one and the other, or of determining, with any tolerable precision, to which of them such symptoms as remain are really owing." (*Pott.*)

A man meets with a fall; a slight concussion of the brain is the consequence, and the patient is instantly stunned. The effects of concussion gradually subside, but an extravasation takes place, and the loss of the senses continues, though from a different cause. Here, according to the principles of Petit, the case would be set down as concussion; yet, things are quite the contrary, the extravasation now keeping up the symptom, which was only temporarily produced by concussion. In many instances, also, the effects of concussion and extravasation exist together; and then how is a surgeon to judge of the nature of the case? (See *Œuvres Chir. de Desault*, t. ii. p. 25.)

"When an extravasation of any kind is made, either upon or within the brain, if it be in such quantity, or so situated, as to disorder the œconomy of the animal, it always produces such disorder, by making an unnatural pressure on the parts where it lies. The nature and degree of the symptoms, hereby produced, are various, and different in different persons, according to the kind, quantity, and situation of the pressing fluid. Sometimes it is merely fluid blood, sometimes blood in a state of coagulation; sometimes it is a clear lymph, and at others blood and water are found mixed together: each of these is found either simple or mixed in different situations, that is, between the skull and dura mater, between the dura and pia mater, or in the natural cavities of the brain called its ventricles; and sometimes, in cases of great violence, they are found at the same time in all these different parts. Sometimes a considerable quantity is shed instantly, at the time of the accident; and sometimes the breach by which the effusion is made is so circumstanced, both as to nature and situation, that it is at first very small, and increases by faster or slower degrees. In the former, the symptoms are generally immediate and urgent, and the extravasation is of the bloody kind; in the latter, they are frequently slight at first, appear after some little interval of time, increase gradually till they become urgent or fatal, and are in such case generally occasioned by extravasated lymph. So that although the immediate appearance of bad symptoms does most certainly imply mischief of some kind or other, yet, on the other hand, no man ought to suppose his patient free from hazard, either because such symptoms do not show themselves at first, or because they appear to be but slight; those which come on late, or, appearing slight at first, increase gradually, being full as much to be dreaded as to consequence, as the more immediately alarming ones; with this material difference between them, that the one *may* be the consequence of a mere concussion of the brain, and may by means of quietude and evacuation go quite off; whereas, the other being most frequently owing to an extravasation of lymph (though sometimes of blood also) within the substance of the brain, are very seldom removed by art." (*Pott.*) No experienced surgeon, I think, can doubt the fact, that many cases, supposed to have been examples of compression from extravasation, and cured by the absorption of the effused blood, were in reality instances, in which the effects of a severe concussion had gradually subsided. (See *Dupuytren, Clin. Chir.* t. ii. p. 493.)

The case of extravasation, between the cranium and dura mater, is almost the only one, which admits of relief from trephining. Mr. Abernethy informs us, that in the cases which he met with, of blood extravasated between the dura and pia mater, on a division of the former membrane being made for its discharge, only the serous part of it could be evacuated; for, the coagulum was spread over the hemisphere of the brain, and had descended, as low as possible, towards its inferior part, so that very little relief was obtained by the operation. (*Surgical Works*, vol. ii. p. 46.) This statement is confirmed by that of Bichat; and the practice inculcated agrees with what Sir Astley Cooper also directs, as will be presently noticed.

Fractures of the cranium, which take place across the lower and front angle of the parietal bone, and the rest of the track of the trunk, and large branches of the spinous artery of the dura mater, are very likely to be attended with a copious extravasation. This vessel, and others more deeply seated, however, may be ruptured, pour out a considerable quantity of blood, and induce urgent symptoms of pressure on the brain, not only without the co-existence of a fracture, but even of any external mark of violence on the scalp.

The effused blood is frequently situated below the part on which the violence has operated; and hence, when such part is pointed out by a wound or discoloration of the scalp, or a fracture, and the symptoms of pressure are considerable, with paralysis on the opposite side of the body, I should have no hesitation about immediately trephining in the situation of the external injury. I have seen many cases in which such practice was justified by the result; and even when no extravasation exists, this plan will sometimes detect a depression of the inner table of the skull, and be the means of saving life, as happened in one very remarkable case, which I trephined at Brussels after the battle of Waterloo. At the same time, it would be wrong to hold out the expectation, that, by acting on this principle, the surgeon will always find blood immediately under the part of the cranium which he perforates. With respect to a fracture also, as a guide to the place for the application of the trephine in cases of extravasation, Desault regards it as fallacious, dissections proving that numerous fractures of the skull are unattended with any effusion of blood immediately under them; and his experience taught him, that the most frequent cases were those, in which there was either extravasation without fracture, or a fracture with blood effused in a part of the head remote from the injury of the bone. (*Œuvres Chir.* t. ii. p. 130.) Even when blood is seen issuing from the fissure, he regards it as no proof of the dura mater being detached, as such blood may proceed from the vessels of the diploe. (p. 31.) But what is to be done, when dangerous symptoms of pressure prevail, without any external mark to denote what part of the head has received the blow, or whether any at all? for, a general concussion of the head may produce an effusion of blood within the cranium. Under these circumstances, Pott was against the operation; and says, that "the only chance of relief is from phlebotomy, and an open belly; by which we may hope so to lessen the quantity of the circulating fluids as to assist nature in the dissipation or absorption of what has been extravasated. This is an effect, which, although not highly improbable in itself, yet is not to be expected from a slight or trifling application of the means proposed. The use of them must be proportioned to the hazard of the case. Blood must be drawn off freely and repeatedly, and from different veins; the belly must be kept constantly open, the body quiet, and the strictest regularity of general regimen must be rigidly observed. By these means, very alarming symptoms have now and then been removed, and people in seemingly very hazardous circumstances have been recovered." Desault also promulgated the same advice, and blamed the doctrine formerly in vogue, that it was better to apply the trephine many times uselessly, than to let a single extravasation remain undetected; for he was firmly convinced, that the trephine, when used on this principle, was a source of greater mischief than the effused blood itself. (*Œuvres Chir.* t. ii. p. 34.) The same doctrine is espoused by Sir Astley Cooper (*Lectures, &c.* vol. i. p. 288.), and, I believe, by all the best modern surgeons.

But should the mode of judging, whether blood lies immediately under the skull, suggested by Mr. Abernethy, prove invariably correct, the question, whether the trephine should be applied or not, may in future be more easily determined. Even when the injured scalp shows where the violence has operated, the criterion about to be noticed may inform us whether we should perforate the bone or not; for though the extravasation is sometimes found immediately under the external mark, yet it often is not so, but is in a part distant from that mark, to which situation we have nothing to lead us, and to which indeed, if we knew it, we could not reach. Mr. Abernethy has observed, "that unless one of the large arteries of the dura mater be wounded, the quantity of blood poured out will probably be inconsiderable, and the slight compression of the brain which this occasions, may not be attended with any peculiar symptoms, or perhaps it may occasion some stupor, or excite an irritation, disposing the subjacent parts to become inflamed. It is indeed highly probable, that, in many cases, which have done well without an operation, such an extravasation has existed. But if there be so much blood on the dura mater as materially to derange the functions of the brain, the bone, to a certain extent, will no longer receive blood from within, and by the operation, performed for its exposure, the pericranium must have been separated from its outside. I believe that a *bone so circumstanced will not be found to bleed;* and I am at least certain it cannot with the same freedom and celerity, as it does when the dura mater remains connected with it internally." (See *Abernethy's Surgical Works*, vol. ii. p. 47.) In some cases, related by this gentleman, there was no hemorrhage; twice he was able, by attending to this circumstance, to tell how far the detachment of the dura mater extended; and often, when symptoms seemed to demand a perforation of the skull, he has seen the operation contra-indicated by the hemorrhage from the bone, and, as the event shewed, with accuracy. Mr. Abernethy admits, however, that in aged persons, and in those in whom the circulation has been rendered languid by the accident, the mode of distinction, which he has pointed out, will be less conclusive.

Pott remarks, that, "if the extravasation be of blood, and that blood be in a fluid state, small in quantity, and lying between the skull and dura mater, immediately under or near to the place perforated, it may happily be all discharged by such perforation, and the patient's life may thereby be saved; of which many instances are producible. But if the event does not prove so fortunate, if the extravasation be so large or so situated that the operation proves insufficient, yet the symptoms having been urgent, general evacuation having been used ineffectually, and a wound or bruise of the scalp having pointed out the part which most probably received the blow, although the removal of that part of the scalp (a simple incision ought to have been said) should not detect any injury done to the bone, yet the symptoms still subsisting, I cannot help thinking that perforation of the cranium is in these circumstances so fully warranted, that the omission of it may truly be called a neglect of having done that which might have proved serviceable, and, *rebus sic stantibus*, can do no harm. It is very true, that no man can beforehand tell whether such operation will prove beneficial or not, because he cannot know the precise nature, degree, or situation of the mischief; but, this uncertainty, properly considered, is so far from being a dissuasive from the attempt, that it is really a strong incitement to make it; it being fully as impossible to know, that the extravasated fluid does *not* lie between the skull and dura mater, and that under the part stricken, as that it *does;* and if the latter should be the case, and the operation be not performed, one, and most probably the only means of relief will have been omitted."

On some of the foregoing points Sir Benjamin Brodie's advice coincides very much with the precepts of Mr. Abernethy, and with the doctrines which have been for many years inculcated in this work. Blood, he observes, is seldom poured out in any considerable quantity between the dura mater and the bone, except in consequence of a laceration of the middle meningeal artery, or one of its principal branches. If, therefore, we find the patient lying in a state of stupor, and discover a fracture with or without depression, extending in the direction of the middle meningeal artery, Sir Benjamin Brodie is an advocate for the trephine. When no fracture is discoverable, but there is other evidence of the injury having fallen on that part of the cranium, under which the middle meningeal artery is situated, the trephine, he says, may be employed on speculation, rather than that the patient should be left to die without any attempt being made for his preservation. (See *Med. Chir. Trans.* vol. xiv. p. 385.)

When there is no interval of sense, between the blow and the coming on of perilous symptoms, it is frequently impossible to determine, whether the mischief be owing to the largeness and suddenness of the extravasation, to the violence of the shock which the brain has received, or to both these causes at once, which unfortunately is too often the case. In this latter complication, indeed, trephining will frequently be of no avail, even though it serve for the entire removal of all pressure off the brain; for the patient may not recover from the violence of the concussion, and never regain his senses. This is no reason, however, why the chance of the operation doing good should not be taken, when there are evident symptoms of pressure. Let us, in these darkened cases, call to mind the sentiments of Pott, who says, "No man, who is at all acquainted with this subject, will ever venture to pronounce or promise success from the use of the trephine, even in the most apparently slight cases: he knows that honestly he cannot; it is enough that it has often been successful where and when every other means has failed. The true and just consideration is this: does the operation of perforating the cranium in such case add at all to that degree of hazard which the patient is in before it is performed; or can he in many instances do well without it? If it does add to the patient's hazard, that is certainly a very good reason for laying it aside, or for using it very cautiously; but, if it does not,—and the only objection made to it is, that it frequently fails of being successful,—surely it cannot be right to disuse that which has often been, not only salutary, but the *causa sine quâ non* of preservation, merely because it is also often unsuccessful, that is, because it is not infallible."

Giving vent to the confined blood "may produce a cure, or it may prove only a temporary relief, according to the different circumstances of different cases. The disappearance, and even the alleviation of the most pressing symptoms is undoubtedly a favourable circumstance, but is not to be depended upon as absolutely portending a good event. Either a bloody, or limpid extravasation may be formed, or forming between the meninges, or upon, or within the brain, and may prove as certainly pernicious in future, as the more external effusion would have done, had it not been discharged; or the dura mater may have been so damaged by the violence of the blow as to inflame and suppurate, and thereby destroy the patient.

"If the disease lies between the dura and pia mater, mere perforation of the skull can do nothing; and, therefore, if the symptoms are pressing, there is no remedy but division of the outer of these membranes. The division of the dura mater is an operation which I have several times seen done by others, and have often done myself. I have seen it, and found it now and then successful; and from those instances of success, am satisfied of the propriety and necessity of its being sometimes done." He next states, however, that wounding the dura mater is itself attended with dangerous consequences. Mr. Abernethy's opinion of such operation has already been given. It is also disapproved of by Sir Astley Cooper, who says, that if blood be not found between the dura mater and skull, do not puncture the dura mater to seek for it, which would be of no use, as the blood is coagulated, and could not escape, being seated under the pia mater, or in the brain itself. (*Lectures, &c.* p. 289.)

If, after the removal of a portion of bone, the dura mater should present itself of a blue colour, be lifted up by blood underneath it, and bulge, as it were, into the aperture, Sir Benjamin Brodie approves of a puncture being made in that membrane; and though he joins Pott in regarding a wound of the dura mater as dangerous, he considers it here justified by circumstances, and supports his advice by a reference to a case, in which Mr. Chevalier thus discharged a considerable quantity of blood, and the patient recovered. (See *Med. and Physical Journ.* vol. viii. p. 505.) He has also adduced another instance of the success of the practice, in the hands of my friend and late neighbour, Mr. Ogle. Neither does M. Velpeau join in the absolute condemnation of it, which, as he conceives, may sometimes be useful. (*De l'Opér. du Trépan*, p. 58.)

"Upon the removal of a piece of bone by means of the trephine, if the operation has been performed over the part where the disease is situated, and the extravasation be of the fluid kind, and between the cranium and dura mater; such fluid, whether it be blood, water, or both, is immediately seen, and is partly discharged by such opening: if, on the other hand, the extravasation be of blood in a coagulated or grumous state, it is either loose or in some degree adherent to the dura mater; if the former of these be the case, it is either totally or partially discharged at the time of, or soon after, the operation, according to the quantity or extent of the mischief; if the latter, the perforation discovers, but does not immediately discharge it." Mr. Pott then lays it down as a rule, that a large extravasation must necessarily require a more free removal of bone than a small one; and a grumous or coagulated extravasation, a still more free use of the instrument.

In applying the trephine, on account of a fracture with depression, Sir Benjamin Brodie deems the removal of a small portion of bone generally sufficient; but, when blood is extravasated on the surface of the dura mater, he recommends the bone to be more freely taken away. He founds this advice on the circumstances of a case, which he has recorded, where a more limited opening did not give a sufficiently ready outlet to the suppuration that ensued, and the patient died. (See *Med. Chir. Trans.* vol. xiv. p. 386.)

The application of the trephine would be unnecessary, if the cranium were broken, and fragments of a certain diameter could be extracted with forceps, so as to leave a free opening for the discharge of the extravasated blood. (See *Velpeau, de l'Opér du Trépan*, p. 55.)

In the treatment of pressure from extravasation, Sir Astley Cooper joins the generality of surgeons in recommending free depletion, in order to prevent inflammation; the bowels, he says, are to be opened, and the patient kept very quiet. "If there be a bruise indicating the spot at which the injury has been sustained, you may trephine, *after every other means has been tried ineffectually*. If a fracture exists, and the symptoms do not yield to depletion, you will trephine to seek the extravasation." (*Lectures*, p. 288.)

All cases of pressure on the brain are attended with hazard of inflammation of this organ, and its membranes. The danger must be averted as much as possible, by applying cold washes to the head, and employing free and repeated bleeding, leeches, antimonials, saline purgatives, and other antiphlogistic means. After the depleting method has been continued some time, blisters may be applied to the head, and the cold wash omitted.

For an account of the various theories entertained, respecting the manner in which pressure operates upon the brain, I must refer to the writings of Sir Charles Bell, M. Serres (*Ann. des Hopitaux*, t. i.), M. Flourens (*Considérations sur l'Opér. du Trépan*, 1830), Sir B. Brodie (*Med. Chir. Trans.* vol. xiv.), and particularly M. Velpeau (*De l'Opér. du Trépan*, p. 89.)

6. Concussion or Commotion of the Brain.

It is observed by Mr. Pott, that "very alarming symptoms, followed sometimes by the most fatal consequences, are found to attend great violence offered to the head; and, upon the strictest examination both of the living and the dead, neither fissure, fracture, nor extravasation of any kind can be discovered. The same symptoms, and the same event are met with, when the head has received no injury at all *ab externo*, but has only been violently shaken; nay, when only the body, or general frame, has seemed to sustain the whole violence." And he afterwards remarks, that "the symptoms attending a concussion are generally in proportion to the degree of violence which the brain itself has sustained, and which, indeed, is cognisable only by the symptoms. If the concussion be very great, all sense and power of motion are immediately abolished, and death follows soon; but, between this degree, and that slight confusion (or stunning, as it is called) which attends most violences done to the head, there are many stages." But besides the foregoing description of concussion, which seems rather to consist in a lesion of function, than in any visible disorganisation, Sir Astley Cooper has found the more violent degrees of it attended with laceration of the brain, and slight extravasation. (*Lectures*, &c. p. 262.) The latter, however, are rather to be considered as compound cases, than as instances of pure concussion. Sir Benjamin Brodie has observed, that the symptoms of concussion do not depend upon any such derangement of the organisation of the brain as admits of being disclosed to us by dissection; yet he thinks the inference not justified, that there is really no organic change. It is difficult, he says, to conceive in what other manner concussion of the brain can operate so as to produce the effects which it is known to produce; and if we consider, that the ultimate structure of the brain is on so minute a scale, that our senses are incapable of detecting it, it is evident that there may be changes and alterations of structure, which our senses are also incapable of detecting. (*Med. Chir. Trans.* vol. xiv. p. 337.)

With respect to the symptoms of concussion, if the blow is slight, the patient is confused, or partially stunned, and at the moment of the injury, has a sensation of flashes of light, or of stars, before his eyes, *tinnitus aurium*, and remains for some moments in a state of hebetude, or as if he were intoxicated. When the blow is more violent, he falls down senseless, and is unable to get up again for several minutes, or even hours, and sometimes he never rises again. Then the skin is pale, the pulse slow, small, and feeble. Respiration seems nearly annihilated, and the patient lies as if in a lethargy. Such condition may quickly terminate in death; but if this does not happen, it is soon remarked, that there is no paralysis; for, on pinching the skin, the patient is made to move; and, afterwards, when the stupor has partially or temporarily subsided, he is continually turning and throwing himself about in bed. At length, if he be spoken to loudly, he endeavours to answer, and opens his eyes. Next come on symptoms of irritation; but nothing that characterises compression, except as a complication in a more advanced stage. (See *A. Velpeau, De l'Opér. du Trépan*, p. 123.)

Mr. Abernethy, I think, has removed a good deal of the perplexity of this subject by dividing concussion into three stages. In fact, without such discrimination, the various descriptions of the symptoms, as given by different writers, cannot be at all reconciled.

"The *first* is, that state of insensibility and derangement of the bodily powers, which immediately succeeds the accident. While it lasts, the patient scarcely feels any injury that may be inflicted on him. His breathing is difficult, but in general without stertor; his pulse intermits, and his extremities are cold. But such a state cannot last long; it goes off gradually, and is succeeded by another, which I consider as the *second* stage of concussion. In this, the pulse and respiration become better, and, though not regularly performed, are sufficient to maintain life, and to diffuse warmth over the extreme parts of the body. The feeling of the patient is now so far restored, that he is sensible if his skin be pinched; but he lies stupid and inattentive to slight external impressions. As the effects of concussion diminish, he becomes capable of replying to questions put to him in a loud tone of voice, especially when they refer to his chief suffering at the time, as pain in the head, &c.; otherwise, he answers incoherently, and as if his attention was occupied by something else. As long as the stupor remains, the inflammation of the brain seems to be moderate; but as the former abates, the latter seldom fails to increase; and this constitutes the *third* stage, which is the most important of the series of effects proceeding from concussion.

"These several stages vary considerably in their degree and duration; but more or less of each will be found to take place in every instance where the brain has been violently shaken. Whether they bear any certain proportion to each other or not, I do not know. Indeed, this will depend upon such a variety of circumstances in the constitution, the injury, and the after-treatment, that it must be difficult to determine.

"With regard to the treatment of concussion, it would appear that in the first stage very little can be done; and, perhaps, what little is done had better be omitted, as the brain and nerves are probably insensible to any stimulants that can be employed. From a loose, and, I think, fallacious analogy between the insensibility in fainting, and that which occurs in concussion, the more powerful stimulants, such as wine, brandy, and volatile alkali, are commonly had recourse to, as soon as the patient can be got to swallow. The same reasoning which led to the employment of these remedies in the *first* stage, in order to recall sensibility, has given a kind of sanction to their repetition in the *second*, with a view to continue and increase it.

"But here the practice becomes more pernicious and less defensible. The circumstance of the brain having so far recovered its powers, as to carry on the animal functions in a degree sufficient to maintain life, is surely a strong argument, that it will continue to do so without the aid of means, which probably tend to exhaust parts already weakened, by the violent action they induce.

"And it seems probable, that these stimulating liquors will aggravate that inflammation which must sooner or later ensue." (*Essay on Injuries of the Head*, p. 59.)

In the first stage of severe examples, the voluntary muscles have lost their power of action. However, respiration and the circulation continue; and hence, the patient is not immediately destroyed, the principal organic nerves, connected with these functions, being derived from the medulla oblongata. (*Dupuytren, Clin. Chir.* t. ii. p. 491.)

In most cases of concussion, the patient vomits after the accident. Sickness and vomiting are generally early symptoms, and seldom continue after the patient has recovered from the first shock of the accident. In the beginning, a torpor exists in the intestinal canal, and there is considerable difficulty in procuring an evacuation; yet afterwards, the feces are sometimes involuntarily discharged; and the bladder becomes distended, so as to require the catheter; but after a time, the urine also comes away involuntarily. There is sometimes bleeding at the nose, and a part of the blood which drops into the throat, is vomited up. The pupils of the eyes are generally natural; but, if changed, both are a little dilated, or sometimes only one. The state of the pupils, however, is differently represented by different writers, and my experience has taught me that it is subject to much variety. In that stage, in which the sensibility of the patient is impaired, but not annihilated, "the pupils contract on exposure to light, and are sometimes more contracted than under ordinary circumstances." (*Sir B. Brodie*, vol. cit. p. 338, 339.) Immediately after the concussion, palpitations are experienced; and respiration, which is then disturbed and irregular, soon becomes quiet again, and goes on so gently, and with so little noise, or motion of the chest, that one might say, the patient does not breathe. This is a characteristic sign. The eyelids are almost always closed, the levatores palpebrarum having lost their power. (See *Dupuytren* in *Clin. Chir.* t. ii. p. 492.) According to Sir Astley Cooper, the pulse, although natural when the patient is undisturbed, scarcely ever fails to be quickened by any exertion made by the patient: and the carotids sometimes pulsate with great force; but the latter symptom is generally not noticed till after a few hours. The state of the pulse is very different, according to the stage of the disorder. In severe cases, the pulse is at first intermitting, irregular, feeble, perhaps scarcely perceptible, and the patient in a condition approaching that of syncope. Such may be his situation for several hours after the accident. When concussion proves fatal, the cause of death is imputed by Sir Benjamin Brodie to this disturbance of the action of the heart. "In general, when the patient has lain for some time in the state which has been described, a reaction of the circulating system takes place, and the pulse beats with greater strength in proportion as the failure of it was greater in the first instance. But where the shock has been unusually severe, there is no such reaction. The pulse becomes more and more feeble, more irregular and intermittent; the extremities grow cold, and at last, the action of the heart being altogether suspended, the patient expires. In some cases, even after reaction has begun to take place, it seems as if the constitution were unequal to the effort: there is another failure of the circulation, the result of which is the same as if the patient had never rallied from the beginning." (*Med. Chir. Trans.* vol. xiv. p. 341.) In the earlier stages, patients swallow, but only when iquids are introduced far back into the pharynx. Digestion is suspended. (*Dupuytren, Clin. Chir.* t. ii. p. 493.)

After concussion, the mind is variously affected, according to the degree of injury which the patient has sustained. In some cases, there is a total loss of mental power; in others, the patient is capable, though with difficulty, of being roused to make a rational answer, but immediately sinks again into coma. Sometimes the memory is lost, while, in other instances, it is only partially impaired. A total forgetfulness of any foreign language is a common effect of concussion. It frequently happens that the patient, when roused, will be perfectly sensible, and answer questions rationally; but, if left undisturbed, the mind appears to be occupied by some particular circumstance (often an incoherent one), of which he is constantly talking. Patients recollect nothing about the mode in which their accidents took place. If the injury has been occasioned by a fall from a horse, they can only remember mounting and riding to some distance, but not that the animal ran away, or threw them; nor, however perfectly they may recover in other respects, do they ever have any recollection of the kind of accident. I attended a lady in Regent's Park, who had suffered a concussion of the brain, from her horses having ran away, and brought her carriage violently against the iron gates of the park. Two or three days previously, she had set fire to her dress, and slightly burnt her neck. After the return of her senses, she remembered nothing about the accident in the park. The change, produced by injuries of the brain, is remarked to be somewhat similar to the effects of age: the patient loses impressions of a recent date, and is sensible of those which he received in his earlier years. But, as Sir Astley Cooper correctly explains, the degree of injury sustained by the brain varies considerably in different cases. Some patients are only stunned, or deprived of sense for a moment; others recover in a few hours; some remain in a great degree insensible for fifteen or twenty days. Some recover entirely; others have afterwards an imperfect memory. A partial loss of sense will be produced in the function of one eye, for deafness in one ear; and the squinting, caused by an injury of the brain, is sometimes permanent. In some cases, a degree of fatuity; in some, great irritability; in others, vertigo, and tendency to severe headach from the slightest excitement, will remain. In one example, seen by Sir Astley Cooper, a remarkable irritability of the stomach, and disposition to vomit, were the permanent consequences of a concussion of the brain. In particular instances, the faculty of readily uttering the proper words for expressing ideas is lost, and never regained, and wrong terms are used. Often the judgment remains enfeebled. (*Lectures*, vol. i. p. 254, &c.) Many of the observations in the foregoing statement coincide with the accounts given of the subject in the writings of Bichat, Desault, and Dupuytren. The latter, after noticing the symptoms of the first stage, and their abatement, describes the pulse as now becoming stronger and more frequent; the eyes intolerant of light, even through the eyelids; the restlessness, and the return of speech, and necessities. The patient now perhaps asks for food, and falls asleep again for twenty-four hours. After one or two such periods of repose, his intellectual faculties are restored; but he is incapable of long-continued attention, or of constant motion. He begins a sentence, but does not finish it. Perhaps, in four or five days, he recovers; but the effects continue a long while; as, for instance, an indisposition, or inability to read, or to enter into long conversation, or mental exertion. He commences a letter, but does not finish it. He experiences a difficulty of digestion, and weakness in walking. A debilitated condition of the genital organs will sometimes continue for several months. (See *Dupuytren*, in *Clin. Chir.* t. ii. p. 494.)

The following passage, extracted from a writer who has already been of material assistance in this article, cannot be too deeply impressed on the memory of every surgical practitioner:—

"To distinguish between an extravasation and commotion, by the symptoms only, is frequently a very difficult matter, sometimes an impossible one. The similarity of the effects in some cases, and the very small space of time which may intervene between the going off of the one and accession of the other, render this a very nice exercise of the judgment. The first stunning or deprivation of sense, whether total or partial, may be from either, and no man can tell from which; but when these first symptoms have been removed, or have spontaneously disappeared, if such patient is again oppressed with drowsiness, or stupidity, or total or partial loss of sense, it then becomes most probable that the first complaints were from commotion, and that the latter are from extravasation; and the greater the distance of time between the two, the greater is the probability not only that an extravasation is the cause, but that the extravasation is of the limpid kind, made gradatim, and within the brain.

"When there is no reason to apprehend any other injury, and commotion seems to be the sole disease, plentiful evacuation by phlebotomy and lenient cathartics, a dark room, the most perfect quietude, and a very low regimen, are the only means in our power; and are sometimes successful." (*Pott.*) When the patient is at all sensible, every thing likely to irritate the mind is to be avoided. (*Sir A. Cooper, Lectures, &c.* p. 279. vol. i.)

With these means should also be associated the constant application to the head of cloths dipped in very cold water, or Schmucker's Frigorific Lotion. When the effects of the violence are not necessarily fatal in a very short time after the accident, the great danger, which is to be guarded against, is certainly inflammation of the brain. Hence the necessity of freely employing the lancet, and antiphlogistic means. The discrimination which Mr. Abernethy introduced into the views of the present subject, by his division of concussion into three stages, has led also to more rational and successful practice. For, though bleeding is now generally allowed to be the great means of relief in concussion, it is not rashly practised at the beginning of many cases, while the pulse can hardly be felt, and the circulation scarcely goes on, and every action in the system is nearly annihilated. But the state of the pulse and circulation is closely watched, and the surgeon bleeds in sufficient time and quantity, to prevent in many instances that immoderate frequency and hardness, which the pulse always has a tendency in these cases to assume immediately the first shock of the accident begins to abate. "Bleeding, (as Sir Astley Cooper correctly notices), may be carried to excess. You must, in the repetition of bleeding, regulate your conduct by the symptoms; observe whether there be any hardness in your patient's pulse, and whether he complains of pain in the head, if he have still the power of complaining. Watch your patient with the greatest possible anxiety ; visit him at least three times a day ; and if you find any hardness of the pulse supervening, after the first copious bleeding, take away a tea-cup full of blood ; but do not go on bleeding him largely ; for you would, by this means, reduce the strength too much, and prevent the reparative process of nature." Sir Astley admits, however, that it is frequently necessary to take away blood after the first bleeding; but he directs this to be generally done in small quantities. He acknowledges, also, that it is sometimes necessary to take away large quantities by repeated bleedings. (P. 271.) The recovery of many cases which have fallen under my own observation, I have imputed to the frequent and even copious abstraction of blood, by means of the lancet, leeches, and cupping ; at the same time I know, that this practice is often carried beyond all moderation, without due attention to those circumstances which I have mentioned as the proper guide.

I believe, with Mr. Abernethy and Sir Benjamin Brodie, that, in the very first stage of concussion, when all the powers of life are depressed, cordials and stimulants can rarely be employed with advantage. The latter gentleman has lately offered some considerations against this practice which merit attention. There are, he observes, sufficient reasons why we should regard that condition of the system, which approaches to syncope, as being mostly conducive to the patient's welfare, and why we should wish to prolong, rather than abridge, the period of its duration. The same blow, which gives rise to symptoms of concussion, he remarks, frequently occasions the rupture of some small vessels within the cranium. The same state of the system, which produces an enfeebled action of the heart, is calculated to prevent the ruptured vessels from pouring out their contents; and the longer it continues, the less is the danger of internal hemorrhage. If we excite the action of the heart with wine and ammonia, we may bring on symptoms of pressure on the brain. If, on the contrary, we watch the gradual restoration of the pulse, and bleed at the proper moment in quantity sufficient to keep down the action of the heart, we may often check extravasation. Sir Benjamin Brodie also argues, that as the state of depression is followed by one of excitement, it is another strong consideration in favour of avoiding stimuli, and having recourse to bleeding in time to prevent the action of the heart from becoming too vehement. (See *Med. Chir. Trans.* vol. xiv. p. 377.)

With respect to emetics, I have no confidence in their usefulness in cases of concussion, and doubt even their safety, especially when the disorder is complicated with extravasation (*Sir A. Cooper, Lectures, &c.* vol. i. p. 276.), a point, often incapable of positive decision.

Purgative and antimonial medicines should be prescribed, and a low regimen enjoined. After bleeding has been freely practised, and the bowels emptied, blisters on the scalp and nape of the neck are frequently very useful in preventing or lessening the tendency to inflammation of the brain and its membranes.

As bleeding from the arm cannot be employed in young children, Sir A. Cooper recommends the exhibition of calomel, with acescent drinks so as to purge them; and leeches, or opening the jugular vein.

For the relief of certain symptoms, frequently remaining after concussion, as pain in the head, giddiness, diminution of sight, and deafness, Sir A. Cooper directs the head to be washed with spirit of wine and water, or the use of the shower-bath. Sometimes he orders the ung. canthar. to be rubbed on the head, and pil. hydrarg. and extr. colocynth. to be given. In cases of nervous debility of an organ, electricity is sometimes useful; and occasionally, in long-continued pains of the head, he forms an issue in the scalp, benefit sometimes resulting even from slight exfoliations. (*Lectures*, vol. i. p. 280.) When any of these complaints seem likely to depend upon effusion of fluid, a thickening of the membranes, or deposits of new matter within the head, from previous inflammation, a course of mercury, and blistering the scalp, or rubbing it with iodine liniments, may be advisable. These measures are infinitely more prudent, than the old custom of trephining.

I cannot conclude this article without adverting to the great propensity to relapse, after patients have long appeared out of every danger from wounds of the head, the bad symptoms sometimes coming on again, and proving fatal, many years after the original injury, as is strongly exemplified in a case related in a work of high character. (See *Schmucker's Vermischte Schriften*, b. i. p. 247.)

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Cooper, Lectures on the Principles, &c. of Surgery, vol. i. 1824. *Sir B. C. Brodie*, in Med. Chir. Trans. vol. xiv. 1828. *Hippolyte Larrey*, Hist. Chir. du Siége de la Citadelle d'Anvers, p. 80. 8vo. Paris, 1833. *A. A. M. Velpeau*, De l'Opération du Trépan, 8vo. Paris, 1834. *M. le Baron Dupuytren*, in Leçons Orales de Clin. Chir. t. ii. p. 490. 8vo. Paris, 1832. *Dudley*, in Transylvania Journ. of Medicine, No. 1., as quoted by Dr. Reese in Amer. ed. of this Dictionary. See TREPHINE.

HEMERALOPIA. According to M. Dujardin, this term is derived from ἡμέρα, the day, ἀλαὸς, blind, and ὦψ, the eye, and its right signification is therefore inferred to be *diurna cæcitudo*, or *day-blindness*. (See *Journal de Méd.* t. xix. p. 348.) In the same sense, Dr. Hillary (*Obs. on the Diseases of Barbadoes*, p. 298. edit. 2.), and Heberden (*Med. Trans.* vol. i. art. 5.), have employed the term.

Hemeralopia, then, which is of very rare occurrence, stands in opposition to the *nyctalopia* of the ancients, or *night-blindness*. Dr. Hillary never met with but two examples. He mentions a report, however, that there are a people in Siam, in the East Indies, and also in Africa, who are subject to the disease of being blind in the day-time, and seeing well by night. (*Mod. Univ. Hist.* vol. vii.)

Scarpa, with the generality of modern writers, considers hemeralopia as an affection, in which the patient sees very well in the day, but not after sunset.

According to Sauvages, hemeralopia (in his nomenclature called *amblyopia crepuscularis*) was in some degree epidemic in the neighbourhood of Montpellier, in villages in damp situations, adjoining rivers, and it particularly affected the soldiers, who slept in the open damp air. They were cured, he says, by blistering, together with emetics and cathartics, and other evacuants. (*Nosol. Method.* class vi. gen. 3. spec. 1.)

The abolition of eyesight by night (observes Mr. Bampfield) has occurred in all ages, and is a common disease of seamen in the East and West Indies, Mediterranean, and in all hot and tropical countries and latitudes, and affects more or less the natives likewise of those regions of the globe. It also occurs frequently among soldiers in the East and West Indies; but, he has been informed, that it is by no means so prevalent amongst them as sailors. It is not an uncommon complaint of the Lascars, employed in the East India Company's ships, trading between India and Europe. It has very rarely indeed affected the officers of his Majesty's, or of the East India Company's ships. Celsus has remarked, that women and virgins, whose menstrual returns are regular, are exempt from this disease (lib. vi. cap. 6.); and it may be observed, that the inhabitants of cold latitudes are less subject to hemeralopia in their own climate, than the natives of tropical countries are in theirs; but, more so, when they visit the tropics. (*Med. Chir. Trans.* vol. v. p. 38.)

"*Hemeralopia*, or *nocturnal blindness* (says Scarpa), is properly nothing but a kind of imperfect periodical amaurosis, most commonly sympathetic with the stomach. Its paroxysms come on towards the evening, and disappear in the morning. The disease is endemic in some countries, and epidemic, at certain seasons of the year, in others.

"At sunset, objects appear to persons affected with the complaint, as if covered with an ash-coloured veil, which gradually changes into a dense cloud, which intervenes between the eyes and surrounding objects. Patients with hemeralopia have the pupil, both in the day and night-time, more dilated, and less moveable, than it usually is in healthy eyes. The majority of them, however, have the pupil more or less moveable in the day time, and always expanded and motionless at night. When brought into a room faintly lighted by a candle, where all the bystanders can see tolerably well, they cannot discern at all, or in a very feeble manner, scarcely any one object: or they only find themselves able to distinguish light from darkness: and at moonlight their sight is still worse. At daybreak they recover their sight, which continues perfect all the rest of the day, till sunset." (Cap. xix. p. 322. ed. 8vo.)

Mr. Bampfield represents the disease as always affecting both eyes. "In general (says this gentleman) the nocturnal blindness is at first partial, the patient is enabled to see objects a short time after sunset, and perhaps will be able to see a little by clear moonlight. At this period of the complaint, he is capable of seeing distinctly by bright candlelight. The nocturnal sight, however, becomes daily more impaired and imperfect, and, after a few days, the patient is unable to discriminate the largest objects after sunset, or by moonlight, &c.; and, finally, after a longer lapse of time, he cannot perceive any object distinctly by the brightest candlelight. If the patient is permitted to remain in this state of disease, the sight will become weak by daylight, the rays of the sun will be too powerful to be endured, whether they are direct or reflected; lippitude is sometimes induced; myopism, or shortness of sight, succeeds; and, in progress of time, vision becomes so impaired and imperfect, that apprehensions of a total loss of sight are entertained; and this dreadful consequence has been known to ensue, where the complaint has been totally neglected, or left to nature, or where ineffectual remedies have been employed." (*Bontius*, p. 73.)

"It has been remarked by some, that the patients are capable of seeing distinctly, at all periods of the complaint, with the aid of a strong artificial light; but, in *bad* cases of hemeralopia, in my practice, the patients positively denied the existence of the sense of distinct sight by very clear candlelight." (*Bampfield in Medico-Chir. Trans.* vol. v. p. 39, 40.)

The duration of the disease, when left to itself, is generally from two weeks to three or six months. Experience has not proved that the disposition to the complaint depends upon any particular colour of the iris, as several writers have conjectured; nor upon the largeness of the eyes, as alleged by Hippocrates. (Lib. vi. sec. 7.)

In idiopathic cases, the health does not in general suffer, and, except in the worst stage, the eye is not altered in appearance. But, in cases of long duration, the pupil, according to Mr. Bampfield, "is often contracted, and the eyes and actions of the patient evince marks of painful irritation, if the eyes are exposed to a vivid light; or if he looks upward. But, if they meet the direct rays of the sun, which in the tropics are always powerful, or a strong glaring reflection of them, pain and temporary blindness are induced, from which the patient recovers, by closing his eyelids for a time to exclude the rays of light, and retiring to the shade. The pupil of the eye is considerably dilated, both by day and night, in the proportion of about one case in twelve, and at night the pupil is often dilated, and does not perform its expansions and contractions, when exposed to the moon, or artificial light. The cases, attended with dilated pupil, were generally those of long duration, &c.

"Europeans, who have been once affected with hemeralopia, in tropical climates, are particularly liable to a recurrence of this disease, as long as they remain in them." (*Bampfield, Op.* cit. p. 42, 43.)

In two examples, described by Dr. Andrew Smith, the pupils were observed to contract and dilate regularly in the day time, according to the quantity of light; but, after sunset, they seemed a little more dilated than natural, and contracted but sluggishly upon exposure to light, while the eyes themselves seemed devoid of their usual energy and vivacity. (See *Edin. Med. and Surgical Journ.* No, 74. p. 22.)

The proximate causes of hemeralopia are not well ascertained. Sleeping with the face exposed to the brilliancy of daylight, the vivid reflection of the sun's rays from the sandy shores of hot countries, and bright moonlight, have been enumerated as exciting causes. Dr. Pye regards the disorder as intermittent. (*Med. Obs. and Inquiries,* vol. i. art. 13.) But, as Mr. Bampfield properly observes, though the complaint is certainly periodical, there is nothing in its character tending to prove, that it is influenced by the same causes as intermittent fever. The latter gentleman conjectures, "that too much light suddenly transmitted to the retina, or for a long period acting on it, may afterwards render it unsusceptible of being stimulated to action, by the weaker or smaller quantities of light transmitted to it by night." (P. 44.) The same sentiment is adopted by Dr. Smith. (*Edin. Med. Journ.* No. 74. p. 23.) Amongst other objections to this explanation, however, it might be remarked, that the patients do not always see, though the light be good; and Mr. Bampfield's own "patients positively denied the existence of distinct sight by very clear candlelight." Besides, if the disease were entirely caused by the sudden or long operation of vivid light, one would conclude, that all persons subjected to that cause ought to have the effect produced, which is far from being the case.

When the tongue is white, and the patient has headach and bilious complaints, M. Lassus thinks the cause of the disease is in the stomach and primæ viæ. The same author likewise states, that hemeralopia attacks debilitated persons, subject to catarrhal affections, residing in damp situations, and living on indigestible food. From the combination of such causes (says he) the disorder was epidemic in the vicinity of Montpellier. (*Sauvage, Nosolog. Méthod.* t. ii. p. 732.); at Belle-Isle sur Mer. (*Recueil d' Observ. de Médecine des Hôpitaux Militaires, par Richard,* t. ii. p. 573.); and hence, it is endemic in watery situations, where the nights are cold and damp. They who expose themselves to this humidity (says M. Lassus), or who navigate along the eastern coasts of Africa, who traverse the Mozambique channel, or sail along the coasts of Malabar and Coromandel, are sometimes attacked by it. (See *Pathologie Chir.* t. ii. p. 542, 543.) Hemeralopia sometimes occurs as a symptom of the scurvy. This fact was noticed by Mr. Telford, in Sir G. Blane's Treatise on Diseases of Seamen, and it is likewise confirmed by Mr. Bampfield, who remarks, that hemeralopia should be referred to the same causes as scurvy, "when the subject of it has for a long period subsisted on a salted diet at sea, &c., and if any other scorbutic symptom be present, such as spongy gums, ecchymoses, saline smell of the secretions, ulcers, with liver-like fungus, &c." (*Medico-Chir. Trans.* vol. v. p. 45.)

In July and August, 1834, hemeralopia was epidemic in two battalions of the 19th Prussian regiment of the line, 138 soldiers having been attacked by it, while quartered at Ehrenbreitstein and Pfaffendorf. Those who suffered were unable to find their muskets, if they put them out of their hands at night, and they experienced such difficulty in discerning at that time, even near objects, that they were afraid of quitting the sentry-box, lest they should not find it again. Surgeon-general Hübner attributed the origin of the disorder to the following causes: — 1. The great heat of the summer. 2. The fatigue of the men in the frequent ascent of the steep heights of Ehrenbreitstein and Pfaffendorf. 3. The frequency of their exercise and parade, on an unshaded and dazzling sandy soil, where also they were exposed to the reflection of the sun from the Rhine. 4. The extreme darkness of their rooms, which rendered their eyes too sensible to bear the open daylight without ill consequences. (See *Med. Zeitung,* and *Dubl. Journ. of Med. Science,* vol. viii. p. 123.)

This disease (according to Scarpa) may commonly be completely cured, and oftentimes in a very short time, by employing emetics, aperient powders, and pills, and a blister on the nape of the neck; and topically, the vapours of ammonia; followed, towards the end of the treatment, by bark, conjoined with valerian. In cases in which the disease has been preceded by plethora, and suppressed perspiration, bleeding and sudorifics are also indicated. (Cap. xix. p. 322. 333.)

One hundred cases of idiopathic, and two hundred of symptomatic or scorbutic hemeralopia, occurred in the practice of Mr. Bampfield, in different parts of the globe, but chiefly in the East Indies. All these cases perfectly recovered: and hence we may infer, that, under proper treatment, a favourable prognosis may always be given.

In a few instances, however, night-blindness is congenital and constitutional, and altogether beyond the reach of any curative measure. It is said sometimes to be hereditary; and the writer of the article *Nyctalopia,* in Dr. Rees's Cyclopædia, was acquainted with an instance, in which it occurred to two children of the same family. A congenital case, which had continued many years without change, and independently of any disease, is related by Dr. Parham. (See *Med. Obs. and Inquiries,* vol. i. p. 122. note.)

The treatment, which Mr. Bampfield adopted, was simple. "A succession of blisters to the temples (says he), of the size of a crown, or half-crown piece, applied tolerably close to the external canthus of the eye, has succeeded in every case of idiopathic hemeralopia which I have seen, &c. The first application of blisters commonly enables the patient to see dimly by candlelight, or perceive objects without the power of discriminating what they are. In some slight cases, which admitted of easy cure, the first application succeeded perfectly. The second application of blisters commonly enables the patient to see by candlelight distinctly, perhaps by bright moonlight, and even half an hour after sunset, or the sight is restored for short periods during the night, and is again abolished. The second application very often effects a perfect recovery. The third, fourth, or fifth applications in succession, generally produce a complete recovery, where the first or second have failed; but some rare instances of very obstinate hemeralopia have required even ten successive blisters to each temple; or, instead of using them in succession, a perpetual vesicatory has been formed on each temple, and maintained until a cure has been accomplished; an event, which has generally followed in a fortnight." (*Bampfield in Medico-Chir. Trans.* vol. v. p. 47, 48.) In some cases, shades over the eyes were worn during the treatment, and a certain time after the cure. The patients were also often directed to bathe their eyes with cold water, two or three times a day.

The epidemic hemeralopia amongst the Prussian soldiers at Ehrenbreitstein, was cured by change of quarters, removing the exciting causes, already specified, and having recourse to cold lotions.

Mr. Bampfield knew of some instances, in which electricity was successfully employed, as a topical stimulus to the eye. He also informs us, that a spontaneous cure sometimes followed the eruption of boils on the head or face, or the formation of abscesses on these parts, or in the ears.

Although blisters will generally effect a cure, there were particular cases in which Mr. Bampfield administered cathartics, such as calomel and the neutral salts. In these examples, the patient had bilious complaints, indicated by a yellow state of the tongue and skin, headach, and pain about the præcordia; or symptoms of indigestion; white tongue, loss of appetite, pain and flatulence of the stomach, &c. With blisters and aperient medicines, Mr. Lawrence sometimes combines cupping on the temples, or nape of the neck. (On *Dis. of the Eye*, p. 570.)

The patients, treated by Dr. Smith, were put into a ward moderately lighted, and their bowels emptied by a gentle cathartic. A blister was then applied to each temple, and kept open with savin cerate. A little of a solution of the oxymuriate of mercury, in the proportion of two grains to an ounce of water was dropped into the eyes twice a day. The purgatives were repeated on the third day, and the quantity of light to which the patients were exposed, was afterwards gradually increased. (See *Edin. Med. Journ.* No. 74. p. 24.)

In scorbutic hemeralopia, blisters are to be deferred until the state of the constitution has been amended, by giving lemon and lime juice, and fresh animal and vegetable food; because hemeralopia often gradually ceases as the scurvy is cured; and before this last event, the blister might produce a scorbutic ulcer. Mr. Bampfield estimates, that about one-third of the cases of scorbutic hemeralopia resist the efficacy of the antiscorbutic regimen and medicines; and consequently must ultimately be treated as idiopathic cases.

The frequent recurrence of this disease, during the patient's continuance in a tropical or hot climate, naturally suggests the propriety of recommending him to return to his native climate, by which change the tendency to a relapse is in general completely removed. (*Bampfield*, in *Medico-Chir. Trans.* vol. v. p. 53.)

Consult Celsus de Re Médica, cap. 6. lib. 6. Galeni Op. Lib. de Oculis, pars iv. cap. 11. 22. Ætii Sermo Septimus, cap. 48. &c. Paul. Æginæ, lib. iii. cap. 48. *Actuarius*, De Method. Med. lib. iv. cap. 11. *Rhascs*, De Ægritud. Ocul. cap. 4. *Avicenna*, lib. iii. fen. 3. tractat. 4. Fabricii Hildani centur. i. obs. 24.; centur. v. obs. 13. *Platner*, Praxis Med. *C. A. Bergen*, et *J. C. Weise*, De Nyctalopia seu Cæcitate Nocturna; *Haller*, Disp. ad Morb. &c. 359. Journal de Médecine et de Chirurgie, an 1756, t. iv. Medical Observations and Inquiries, vol. i. Recueil d'Observations de Médecine des Hôpitaux Militaires, par *Richard*, t. ii. *Duport*, Mémoire sur la Goutte Sereine Nocturne épidémique, ou Nyctalopie. Observations on Tropical Nyctalopia, by *Mr. J. Forbes*, in Edinb. Medical and Surgical Journal, No. xxviii. p. 417, et seq. *Richter*'s Anfangsgründe der Wundarzneykunst, b. iii. p. 483, et seq. *Schmucker*'s Chirurgische Schriften, band. 2. Saggio di Osservazioni e d'Esperienze sulle Principali Malattie degli Occhi di *Antonio Scarpa*, p. 322, et seq. edit. 8vo. *Venezia*, 1802. *Lassus*, Pathologie Chirurgicale, t. ii. p. 539. edit. 2. *Rees*'s Cyclopædia, art. Nyctalopia. A Practical Essay on Hemeralopia, or Night-blindness, commonly called Nyctalopia, by *R. W. Bampfield*, in Medico-Chirurgical Trans. vol. v. p. 32, et seq. *A. Simpson* on Hemeralopia, 8vo. Glasgow, 1819. *C. H. Weller*, Manual of the Dis. of the Eye, transl. by *D. Monteath*, vol. ii. p. 142. 8vo. Glasgow, 1821. *Good*'s Study of Medicine, vol. iv. p. 203. edit. 3. 1829. *W. Lawrence* on Dis. of the Eye, p. 568. 8vo. Lond. 1833. *Dr. A. Smith*, in Edinb. Med. and Surgical Journ. No. lxxiv. *W. Mackenzie* on Dis. of the Eye, p. 880, ed. 2. 8vo. Lond. 1835. *Robert Middlemore*, on Dis. of the Eye, vol. ii. p. 225. 8vo. Lond. 1835. *H. E. C. Richter*, Scriptores Ophthalmologici Minores, vol. iii. Dublin Journ. of Med. Science, vol. viii. p. 123. 8vo. 1835

HEMIOPIA. (from ἥμισυς, half, and ὦψ, the eye.) A certain disorder of the eye, in which the patient cannot see the whole of any object which he is looking at, but only a part of it. Sometimes he sees the middle, but not the circumference; sometimes the circumference, but not the centre; while, on other occasions, it is only the upper or lower half which is discerned. Sometimes objects are seen thus imperfectly, whether distant or near; sometimes only when they are near, and not at a great distance.

The causes of hemiopia are divided by Richter into four kinds.

To the first belong opacities of the cornea and crystalline lens, especially such as destroy the transparency of only a certain portion of these parts. The cure of this species of hemiopia depends upon the removal of the partial opacity from which it originates. (See CATARACT, and CORNEA, *Opacities of*.)

Under certain circumstances, persons, whose upper eyelids cannot be properly raised, are affected with hemiopia. They can only discern the lower half of an object, which is near and of large size, unless they go farther from it, draw their heads backward, or turn their eyes downward.

The pupil, in particular instances, becomes drawn away from the middle of the iris, or there may be a separation of the iris from the margin of the cornea by external violence, or other causes.

Each of these occurrences may cause hemiopia of an incurable kind.

The foregoing species of hemiopia are merely effects of other diseases. The fourth and last kind is the most important, being generally regarded as an independent disorder. Sometimes it appears to be the effect of a sudden and transient irritation, producing a morbid sensibility in the optic nerve.

The causes of this sort of case, if we can credit Richter, are mostly seated in the abdominal viscera. When the affection is more durable, forming what has been termed *amaurosis dimidiata*, the same treatment is indicated as in *amaurosis;* in which, indeed, it often terminates. (*Richter, Anfangsgr. der Wundarzn.* b. iii. kap. 17.)

Dr. Wollaston, who experienced two attacks of hemiopia, and wrote a paper on the semidecussation of the optic nerves, concluded that the disorder might depend upon injury of one of the thalami, occasioning insensibility of the right or left halves of the retinæ, according to the nervous filaments implicated. (See *Phil. Trans. for* 1824, p. 224.) For reasons against this hypothesis, consult *Mackenzie on Dis. of the Eye*, ed. 2. p. 892.)

HEMORRHAGE. (from *αἷμα*, blood, and *ῥήγνυμι*, to break out.) *Bleeding. Effusion, or loss of blood.*

This is doubtless one of the most important subjects in surgery. The fear of hemorrhage retarded the improvement of our profession for ages; the ancients, ignorant how to stop bleeding, were afraid to cut out the most trivial tumour, or they did so with terror. They generally performed slowly and imperfectly, by means of burning irons or ligatures, the same operations which the moderns execute quickly and safely with a knife. If the old surgeons ventured to amputate a limb, they only did so, after it had mortified, by dividing the dead parts; and so great was their apprehension of hemorrhage, that they only dared to cut parts which could no longer bleed. (*John Bell's Principles of Surgery*, vol. i. p. 142.) But not only as a consequence of surgery, is hemorrhage to be feared; it is also one of the most alarming accidents which surgery is called upon to relieve. "*Un sentiment naturel attache à l'idée de perdre son sang; un terreur machinale, dont l'enfant qui commence à parler, et l'homme le plus décidé, sont également susceptibles. On ne peut point dire, que cette peur soit chimérique. Si l'on comptoit ceux, qui perdent la vie dans une bataille, on verroit, que les trois quarts ont péri par quelque hemorrhagie; et dans les grandes opérations de chirurgie cet accident est presque toujours le plus formidable.*" (*Morand, Mém. de l'Acad. de Chir.* vol. v. 8vo.)

As the blood circulates in the arteries with much greater impetus and rapidity than in the veins, it necessarily follows, that their wounds are generally attended with more profuse hemorrhage, than those of the latter vessels, and that such hemorrhage is more difficult to suppress. However, as the blood also flows through veins of great magnitude with much velocity, bleeding from them, if they lie deeply, is frequently highly dangerous, and sometimes unavoidably fatal. When a large artery is wounded, the blood is of a bright scarlet colour, and gushes from the vessel *per saltum;* but, if the artery be of inferior size, the blood, which first spouts from it, does not issue *per saltum*, and it is not until the first gush has subsided, that the stream takes place in jets. (See *J. W. Earle*, in *Lond. Med. Gaz.* vol. xvi. p. 9.) The blood issues from a vein in an even unbroken stream, and is of a dark purple red colour. It is of great practical use to remember these distinguishing differences, between arterial and venous hemorrhage, because, though in both cases the oozing of blood may be equal in quantity, yet, in the latter instance, the surgeon is often justified in bringing the sides of a wound together, without taking farther means to suppress the bleeding, while it might not be proper to adopt the same conduct, were there an equal discharge of arterial blood.

Dr. Jones has favoured the world with a matchless work on the present subject; and as one grand object of this Dictionary is to present a careful account of the principal improvements in surgical science, I shall first endeavour to make the reader acquainted with the more accurate doctrines first promulgated by this gentleman relative to the subject of hemorrhage. Afterwards, the surgical means, to be practised in different cases, will be considered.

The sides of the arteries are divisible into three coats. The *internal one* is extremely thin, and transparent and smooth, with an appearance somewhat like that of a serous membrane. It is elastic and firm (considering its delicate structure) in the longitudinal direction, *but so weak in the circular as to be very easily torn by the slightest force applied in that direction.* Its diseases prove, that it is vascular, and probably it is sensible. The experiments of M. Manec prove, that it secretes an unctuous matter, which facilitates the course of the blood; another fact, in confirmation of its vascularity. (See *Manec, Traité de la Ligature des Artères;* Paris, 1832, in fol.)

The *middle coat* is the thickest, and is composed of fibres, all arranged in a circular, or, as is sometimes alleged, in a spiral manner; they differ, however, from common muscular fibres in being more elastic, by which they tend to keep a dead artery open, and of a cylindrical form. They differ also from common muscular fibres in the facility with which they are divided by any trivial pressure, whether made with the ligature, forceps, or the nail. (See *J. Lisfranc, De l'Oblitération des Artères*, p. 9.) Another difference, is, the absence of fibrine from the fibrous coat of an artery. As this middle coat has no longitudinal fibres, *the circular fibres are held together by a slender connection, which yields readily to any force, applied in the circumference of the artery.* It easily gives way, whether the force is exerted in the direction of the diameter, or in that of the course of the vessel. (See *J. L. Sanson, Des Hemorrhagies Traumatiques*, p. 33.)

The *external coat* is remarkable for its whiteness, density, and great elasticity. It adheres to the middle coat by means of very fine reddish filaments, analogous to those which unite the middle to the internal coat, and it manifestly receives the *vasa vasorum* (See *J. L. Sanson, Op.* cit.) *When an artery is surrounded with a tight ligature, its middle and internal coats are as completely divided by it as they could be by a knife, while the external coat remains entire.* (*Jones.*)

If an artery be extended longitudinally, the internal tunic is first ruptured, and then the middle one; but, the external coat will admit of being elongated to a great extent, before it will be torn. If an artery is twisted, rents are formed in the internal coat, and next in the middle one; but it is difficult to produce a complete rupture of the external tunic. If an artery is struck and forcibly contused; or if it is surrounded with a tight ligature; its internal and middle coats are readily divided, but the external one still makes resistance. (See *L. J. Sanson, Des Hemorrhagies Traumatiques*, p. 33.)

In addition to these three coats, it would appear from the researches of M. Malgaigne, that, in the aorta, and the large trunks derived from it, there is interposed between the internal and fibrous coats, one, which he has named *sclerous*, which renders the aorta stronger and more rigid than the pulmonary artery; and is the seat of various earthy, steatomatous, and cartilaginous formations, met with in the former vessel. It is certainly remarkable, that no good specimen of an ossification of the pulmonary artery, has ever been noticed. (See *J. Lisfranc, De l'Oblitération des Artères*, p. 10.)

Besides these proper coats, all the arteries, in their natural situations, are connected, by means of fine cellular tissue, with surrounding membranous sheaths. *If an artery be divided, the divided parts, owing to their elasticity, recede from each other, and the length of the cellular tissue, connecting the artery with the sheath, admits of its retracting a certain way within the sheath.*

Another important fact is, *that when an artery is divided, its truncated extremities contract in a greater or less degree, and the contraction is generally, if not always, permanent.*

Arteries are furnished with arteries, veins, absorbents, and nerves; *a structure, which makes them susceptible of every change to which living parts are subjected in common; enables them to inflame, when injured, and to pour out coagulating lymph, by which the injury is repaired, or the tube permanently closed.* (See *Jones on Hemorrhage.*)

Petit, the surgeon, in 1731, first endeavoured to explain the means, which nature employs for the suppression of hemorrhage. He thought that bleeding from a divided artery is stopped by the formation of a coagulum of blood, which is situated partly *within*, and partly *without* the vessel. The clot, he says, afterwards adheres to the inside of the artery, to its orifice, and to the surrounding parts; and he adds, that when hemorrhage is stopped by a ligature, a coagulum is formed above the ligature, which only differs in shape from the one which takes place when no ligature is employed. His theory leads him to recommend compression for the support of the coagulum.

In 1736, Morand published additional interesting remarks. He allowed, that a coagulum had some effect in stopping hemorrhage; but contended, that a corrugation, or plaiting, of the circular fibres of the artery which diminish its canal, and a shortening and consequent thickening of its *longitudinal ones*, which nearly rendered it impervious, had some share in the process. He thought that the cavity of an artery might be obliterated, by the puckering, or corrugation, when *circular pressure, like that of a ligature, was made.*

Morand erred chiefly in his mode of explanation, and in his belief in the existence of longitudinal fibres, which no modern anatomists admit; for the *contraction* and *retraction* of divided arteries are indisputable facts, and, as Dr. Jones remarks, this does not affect the truth of his general conclusion, *that the change, produced on a divided artery, contributes with the coagulum to stop the flow of blood.*

Mr. S. Sharp (2d edit. of *Operations of Surgery*, 1739) supported the same doctrine. "The blood-vessels, immediately upon their division, bleed freely, and continue bleeding, till they are either stopped by art, or at length contracting, and withdrawing themselves into the wound, their extremities are shut up by coagulated blood."

Pouteau (*Mélanges de Chirurgie*, 1760), denied, that a coagulum is always found after an artery is divided; and when it is, he thought it only a feeble subsidiary means towards the suppression of hemorrhage. He contended, that the retraction of the artery had not been demonstrated, and could not be more effectual than a coagulum. His theory was, that the swelling of the cellular membrane, at the circumference of the cut extremity of the artery, forms the principal impediment to the flow of blood; and that a ligature is useful in promoting a more immediate and extensive induration of the cellular substance.

Gooch, White, Aikin, and Kirkland, all oppose Petit's doctrine of coagulum. The first blends some of Pouteau's theory with his own, by observing, that "when a small artery is totally divided, its retraction may bring it under the surrounding parts, and with the natural contraction of the diameter of its mouth, assisted by the compressive power of those parts, increased by their growing tumid, the efflux of blood may be stopped."

White was convinced, from what Gooch had suggested, and Kirkland confirmed, that the arteries, by their natural contraction, coalesce as far as their first ramification.

Dr. Jones admits, that an artery contracts after it has been divided, and his experiments authorise him to say, that the contraction of an artery is an important means, but certainly not the only, nor even the chief means, by which hemorrhage is stopped. When the artery is above a certain size, the impetuous flow of blood through the wound of the artery would resist the contraction of the vessel in such a degree, that the consequences would be fatal in almost every instance, were it not for the formation of coagulum.

Mr. J. Bell supposed, that when hemorrhage stops of its own accord, it is neither from the retraction of an artery, nor the constriction of its fibres, nor the formation of clots, but by the cellular tissue which surrounds the artery being injected with blood. I must refer the reader to Dr. Jones's work for a complete exposure of the inconsistencies and absurdities in Mr. Bell's account of his own theory. (See p. 25, &c.) Dr. Jones concludes his criticisms on Mr. Bell with observing, that if this gentleman really mean to confine his doctrine of the natural means of suppressing hemorrhage to the injection of the cellular tissue round the artery with blood, he dwells improperly on one of the attendant circumstances, to the exclusion of the retraction and contraction of an artery, and the formation of a distinct clot, all primary parts of the process.

The blood, besides filling the cellular tissue round the artery, also fills that which is at the mouth of the artery in a particular manner; for the divided vessel, by its retraction within its cellular sheath, leaves a space of a determinate form, which, when all the circumstances necessary for the suppression of hemorrhage operate, is gradually filled up by a distinct clot. (*Jones.*)

Arteries of the fourth or fifth order, like those of the forearm and leg, have not any well-defined sheath; and hence the constantly greater difficulty of insulating small vessels than large. (See *P. P. Manec, de la Ligature des Artères*, p. 3.)

Means of Nature in stopping Bleeding from divided Arteries.

Dr. Jones has given a faithful and accurate detail of a series of experiments on animals, which demonstrate, "that the blood, the action, and even the structure of the arteries, their sheath, and the cellular substance connecting them with it," are concerned in stopping bleeding from a divided artery of moderate size, in the following manner:—"An impetuous flow of blood, a sudden and forcible retraction of the artery within its sheath, and a slight contraction of its extremity, are the immediate, and almost simultaneous, effects of its division. The natural impulse, however, with which the blood is driven on, in some measure counteracts the retraction, and resists the contraction of the artery. The blood is effused into the cellular tissue, between the artery and its sheath, and passing through that canal of the sheath, which had been formed by the retraction of the artery, flows freely externally, or is extravasated into the surrounding cellular tissue, in proportion to the open or confined state of the wound. The retracting artery leaves the internal surface of the sheath uneven, by lacerating or stretching the cellular fibres that connected them. These fibres entangle the blood as it flows, and thus the foundation is laid for the formation of a coagulum at the mouth of the artery, and which appears to be completed by the blood, as it passes through this canal of the sheath, gradually adhering and coagulating around its internal surface, till it completely fills it up from the circumference to the centre." (*Jones*, p. 53.)

The effusion of blood into the surrounding cellular tissue, and between the artery and its sheath; but, in particular, the diminished force of the circulation from loss of blood, and the speedy coagulation of this fluid under these circumstances, most essentially contribute, says Dr. Jones, to the desirable effect.

It appears then, that a coagulum, which Dr. Jones calls the *external* one, situated at the mouth of the artery, and within its sheath, forms the first complete obstacle to the continuance of bleeding; and though it seems externally like a continuation of the artery, yet, on slitting open this vessel, its termination can be plainly observed, with the coagulum shutting up its mouth, and contained in its sheath.

No collateral branch being very near the impervious mouth of the artery, the blood just within it is at rest, and usually forms a slender conical coagulum, which neither fills up the canal of the artery, nor adheres to its sides, except by a small portion of the circumference of its base, near the extremity of the vessel. This coagulum is distinct from the former, and what Dr. Jones calls the *internal* one.

The description given by Mr. Guthrie of this subject, differs in some respects from that of Dr. Jones. The contraction of the divided end of the artery is alleged by Mr. Guthrie "to be confined, in the first instance, to its very extremity, so that the barrier, opposing the flow of blood, is formed by this part alone. This contraction goes on, however, increasing for the space of an inch, and the inside of this contracted inch of the vessel is filled up with an internal coagulum, which takes the shape of, and *adheres to, the inside of the artery*, rarely extending as far as a collateral branch, or under almost any circumstances, beyond a couple of inches. (*On Dis. and Injuries of Arteries*, p. 247.)

The cut end of the artery next inflames, and the vasa vasorum pour out lymph or fibrine, which fills up the extremity of the artery, is situated between the internal and external coagula, and is somewhat intermingled with them, or adheres to them, and is firmly united all round to the internal coat of the vessel. Dr. Jones further states, that the permanent suppression of hemorrhage chiefly depends on this coagulum of fibrine; but, that the end of the artery is also secured by a gradual contraction, which it undergoes, and by an effusion of fibrine between its tunics, and into the surrounding cellular tissue; whereby these parts become thickened, and so incorporated with each other, that one cannot be discerned from the other. Should the wound in the integuments not heal by the first intention, the coagulating lymph, soon effused, attaches the artery firmly to the subjacent and lateral parts, gives it a new covering, and entirely excludes it from the outward wound.

The same circumstances are also remarkable in the portion of the vessel, most remote from the heart. Its orifice, however, is usually more contracted, and its external coagulum smaller, than the one which attaches itself to the other cut end of the artery. (*Jones on Hemorrhage*, p. 56.)

According to Mr. Guthrie's observations, the lower end of a divided artery is more prone to secondary hemorrhage, than the upper; and this he believes to be so much the fact, that, when hemorrhage returns, after having been arrested for a period of four hours, it is in all probability from the lower end. This, he further observes, may always be known by the "*darker colour of the blood, and by its flowing out in a continuous stream*, in the same manner as water rises from a spring, and without an arterial impulse. The surgeon has no right to believe, that the blood comes from the upper extremity of the artery, unless it is of a florid, scarlet, arterial colour, when it will usually rush out with force, if not with undisguised arterial impetus." The greater disposition to secondary hemorrhage in the lower, than the upper end of the artery, is thought by Mr. Guthrie to depend upon the retraction and contraction of the former, being neither so perfect, nor so permanent as in the latter; a statement at variance with that of Jones. He suspects, also, that the internal coagulum is in many instances altogether wanting, or very defective in its formation. (See *G. J. Guthrie, on the Dis. and Injuries of Arteries*, p. 248.) We have seen, that Dr. Jones found the external coagulum smaller here, than that which is formed over the mouth of the end of the artery nearest the heart. The darker colour of the blood from the distal end of the artery, is ascribed by M. Sanson to its previous passage through the capillary vessels; and the fact, he says, was observed by John Hunter. (*Des Hemorrhagies Traumatiques*, p. 45.)

The impervious extremity of the artery no longer allowing blood to circulate through it, the portion, which lies between it and the first lateral branch, gradually contracts, till its cavity is completely obliterated, and its tunics assume a ligamentous appearance. In a few days, the external coagulum, which in the first instance stopped the hemorrhage, is absorbed, and the coagulating lymph, effused around it, and by which the parts were thickened, is gradually removed, so that they resume again their cellular texture.

At a still later period, the ligamentous portion is reduced to a filamentous state, so that the artery is, as it were, completely annihilated, from its cut end to the first lateral branch; but, long before this final change is accomplished, the inosculating branches have become considerably enlarged, so as to establish a free communication between the disunited parts of the main artery.

As Mr. Guthrie observes, out of four or five inches of the artery, two or three will be impervious, and the remaining part very much contracted, although, perhaps, still permeable by a probe. The accompanying nerve, where there is one, has undergone a change, the very reverse of that of the artery, its cut extremity having become enlarged, or bulbous, the nerve gradually diminishing upwards until it resumes its proper size. (*On Dis. and Inj. of Arteries*, p. 248.)

When an artery has been divided *at some distance from a lateral branch*, three coagula are formed: one of blood, externally, which shuts up its mouth; one of lymph, just within the extremity of its canal; and one of blood, within its cavity, and contiguous to that of lymph. But, *when the artery has been divided near a lateral branch, no internal coagulum of blood is formed.* (*Jones*, p. 63.)

The external coagulum is always formed, when the divided artery is left to nature: not so, however, if art interfere, for, under the application of the ligature, it can never form. If agaric, lycoperdon, or sponge, be used, its formation is doubtful, depending entirely upon the degree of pressure that is used; but the internal coagulum of blood will be equally formed, whether the treatment be left to art or nature, if no collateral branch be near the truncated extremity of the artery; and, lastly, effused fibrine, which, when in sufficient quantity, forms a distinct coagulum, just at the mouth of the artery, will be always found, if the hemorrhage be permanently suppressed. (*Jones*, p. 74.)

MEANS WHICH NATURE EMPLOYS FOR SUPPRESSING THE HEMORRHAGE FROM PUNCTURED OR PARTIALLY DIVIDED ARTERIES.

The suppression of hemorrhage by the natural means is sometimes more easily accomplished, when an artery is completely divided, than when merely punctured, or partially divided. Completely dividing a wounded artery was one means practised by the ancients for the stoppage of hemorrhage: the moderns frequently do the same thing, when bleeding from the temporal artery proves troublesome.

Dr. Jones has related many experiments, highly worthy of perusal, and which were undertaken to investigate the present part of the subject of hemorrhage. He candidly acknowledges, however, that, in regard to the temporary means by which the bleeding from a punctured artery is stopped, he has but little to add to what Petit has explained, in his third publication on hemorrhage. (*Mém. de l'Acad. des Sciences*, 1735.) The blood is effused into the cellular substance, between the artery and its sheath, for some distance, both above and below the wounded part; and when the parts are examined, a short time after the hemorrhage has completely stopped, we find a stratum of coagulated blood between the artery and its sheath, extending from a few inches below the wounded part to two or three inches above it, and somewhat thicker, or more prominent over the wounded part, than elsewhere.

Hence, rather than say that the hemorrhage is stopped by a coagulum, it is more correct to say, that it is stopped by a thick lamina of coagulated blood, which, though somewhat thicker at the wounded part, is perfectly continuous with the coagulated blood lying between the artery and its sheath. (*Jones*, p. 113.)

When an artery is punctured, the immediate hemorrhage, by filling up the space, between the artery and its sheath with blood, and consequently, distending the sheath, alters the relative situation of the puncture in the sheath to that in the artery, so that they are not exactly opposite to each other; and, by this means, a layer of blood is confined by the sheath over the puncture in the artery, and, by coagulating there, prevents any further effusion of blood.

But this coagulated blood, like the externa coagulum of a divided artery, affords only a temporary barrier to the hemorrhage; its permanent suppression is effected by a process of reparation, or of obliteration.

Dr. Jones's experiments prove, that an artery, if wounded only to a moderate extent, is capable of reuniting and healing so completely, that, after a certain time, the cicatrisation cannot be discovered, either on its internal or external surface; and that even oblique and transverse wounds, (which gape most), when they do not open the artery to a greater extent than one fourth of its circumference, are also filled up and healed by an effusion of coagulating lymph from their inflamed lips, so as to occasion but little or no obstruction to the canal of the artery. The utmost magnitude of a wound, which will still allow the continuity of the canal to be preserved, is difficult to be learned; for, when the wound is large, but yet capable of being united, such a quantity of coagulating lymph is poured out, that the canal of the vessel, at the wounded part, is more or less filled up by it. And, when the wound is still larger, the vessel soon becomes either torn, or ulcerated completely across, by which its complete division is accomplished.

Béclard made a series of experiments upon dogs, whose arteries are said not to differ much from those of man, though *the impulse of the heart is not so strong, and the blood is more coagulable;* two circumstances, which should be duly considered in applying any of the inferences drawn from such experiments to the human subject. "In his first experiment, he pricked the femoral artery with a needle; the blood flowed, but soon stopped. On removing the coagulum it again flowed, but in a smaller stream: it gradually ceased to bleed, and finally stopped, though the coagulum was again scraped off. On examination of the artery, no trace of the cicatrix was found. Several similar experiments had the same result. In experiment 4, he denuded the femoral artery, and made a longitudinal cut in it, from two to three lines. The lips of the wound were seen in contact during the diastole of the ventricle, and to be separated by a jet of blood during the systole. The blood was stopped by a coagulum; this was removed twice, and each time the blood flowed in a diminished stream, but the animal died. In experiment 6 he made the same incision, but did not detach the sheath from the artery, and the wound was left to nature. The hemorrhage was not great; there was an infiltration of blood into the sheath, the size of an almond, which at the end of some days began to diminish, and disappeared in two or three weeks. On the limb being examined, fifteen days afterwards, a little white ridge was found adhering firmly to the artery, and to the sheath, and completely closing the wound. In the interior, there was a depressed longitudinal cicatrix of the breadth of the fifth of a line. *The canal was regular and pervious* through its whole extent.

"In experiments 7, 8, 9, he made transverse incisions of $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ of the circumference of the femoral artery, *separated from its sheath:* all the animals died. In experiment 10, he made a transverse incision through $\frac{1}{4}$ of the the circumference, *without disturbing the sheath*. The bleeding was stopped by a coagulum, but, on the animal moving, it again flowed, and the dog died. But, in the next experiment of the same kind, the blood was stopped by a coagulum, and the artery was closed by nearly the same process as in the 6th experiment. So complete was the cure, at the end of six weeks, that the external part of the artery did not show any mark of a wound, and the cicatrix was scarcely observable on the interior surface. In his 12th experiment, he cut one-half of the circumference; the animal died; and so did it in several similar experiments. In experiment 13, he cut $\frac{3}{4}$ of the circumference: after the animal was much reduced, the bleeding ceased, and the artery was closed in the same manner that it is when the section is complete.

"From these experiments, he concludes, that wounds of the arteries of dogs are cured by nature, when they are only occasioned by a puncture, or a longitudinal incision, whether the artery be denuded or not; but, when arising from transverse incisions, they are always mortal if the artery be laid bare. If the artery retain its sheath, and the wound be $\frac{1}{4}$, or $\frac{3}{4}$ of the circumference, it may be cured by the efforts of nature; but, it is always fatal, if one-half of it be cut through." (See *Mém. de la Soc. Méd. d'Emulation*, t. 8. p. 569.) The inferences respecting the curability of a wound, extending through $\frac{3}{4}$ of the circumference, and the incurability of one that affects only one half of the circumference of the vessel, I should presume, must require further examination, notwithstanding an accidental faintness, produced by the sudden loss of blood in the first instance, may have been the means of saving one or two of the animals on which Beclard made his experiments.

This author thinks it probable, that a puncture, or longitudinal incision, in the artery of a man, may be cured by nature; but that a transverse wound never cicatrises properly, as the clot becomes displaced, or, if a cicatrix be formed, it will be distended and torn.

One fact, made out by the same professor, is, that when an artery is deprived of its sheath for an extent greater than its distance of retraction, the hemorrhage is mortal. I have not looked over the original paper; but it appears to me, that it would be desirable to know precisely the size of the arteries which the author is referring to, when he is making some of the above inferences. The size and condition of each animal, the subject of experiment, should also be particularly specified; as experiments made on the femoral artery of a lady's lap-dog, would surely not have the same results as those performed on the same artery of a large terrier or Newfoundland dog.

According to Dr. Jones, the lymph which fills up the wound of an artery, is poured out very freely both from the vessel and surrounding parts, and it accumulates around the artery, particularly over the wound, where it forms a more distinct tumour. The exposed surrounding parts at the same time inflame, and pour out coagulating lymph, with which the whole surface of the wound becomes covered, and which completely excludes the artery from the external wound. This lymph granulates, and the wound is filled up and healed in the usual manner. (See *Jones on Hemorrhage*, p. 113, &c.)

Surgical Means of suppressing Hemorrhage.

It must be plain to every one who understands the course of the circulation, that pressure, made on that portion of a wounded artery which adjoins the wound towards the heart, must check the effusion of blood. The current of blood in the veins, running in the opposite direction, requires the pressure to be applied to that side of the wound, which is most remote from the heart. However, on account of the freedom and facility with which the blood is transmitted through the anastomoses, from the portion of the artery above the point of pressure into the lower continuation of the artery, such pressure will often only check, and not effectually stop, the bleeding, unless the part of the vessel directly below the wound be also compressed or secured. As pressure is the most rational means of impeding hemorrhage, so it is the most effectual; and almost all the plans employed for this purpose, are only modifications of it. The tourniquet, the ligature, the application of a roller and compresses, even agaric itself, only become useful in the suppression of hemorrhage, on the principle of pressure: the cautery, caustics, and styptics, however, have a different mode of operation.

In order to prevent a wounded person from dying of hemorrhage, Celsus advised the wound to be filled with dry lint, over which was laid a sponge dipped in cold water, and pressed on the part with the hand. If, notwithstanding these means, the hemorrhage should continue, he recommends repeatedly applying fresh lint, wet with vinegar; but he is against the use of corroding escharotic applications, on account of the inflammation which they produce, or only sanctions the employment of the mildest ones. When the hemorrhage resists these methods, *he advises two ligatures to be applied to the wounded part of the vessel, and then dividing the portion situated between them:*—"*Quod si illa quoque profluvio vincuntur, venæ, quæ sanguinem fundunt, apprehendendæ, circaque id, quod ictum est, duobus locis deligandæ, intercidendæque sunt, ut et in se ipsæ coeant, et nihilominus ora præclusa habeant.*" (Lib. 5. cap. 26.) When the ligature was impracticable, the wound bled dangerously, and no large nerves, nor muscles, were situated in the bleeding part, Celsus proposed the actual cautery.

Galen also mentions tying the vessels for the purpose of stopping hemorrhage; and there are some traces of the same information in other authors, who lived before him, as Archigenes and Rufus. Probably, however, the ligature was little used at these early periods, as may be inferred from the multitude of astringents, caustics, and other applications, which were advised for stopping bleeding, and in which less confidence would have been put, had the use of the ligature been familiarly known. No one can doubt that, if the old surgeons had had many opportunities of seeing the advantages of the ligature, they would soon have used it after amputations; but so far were they from adopting such practice, that Albucasis, a long while afterwards, refused to amputate at the wrist, lest he should see his patient bleed to death.

Paré is considered as the first, who regularly employed the ligature after amputation. His method having been attacked, he modestly defends it in the part of his works entitled, *Apologie*, where he takes great care to impute the origin of it to the ancients; and cites many of them, who had made mention of it. However, he thinks its utility in amputations of such consequence, that he ascribes his first adoption of this practice to inspiration of the Deity.

The method, in which the ancients placed most confidence, for stopping hemorrhage after the amputation of a limb, was the cauterisation of the cut vessel, and surrounding flesh. The parts, thus affected by the heat, formed an eschar, of greater or less thickness, which blocked up the opening of the vessel, and hindered the blood from escaping. The separation of the eschar, however, which frequently took place too soon, occasioned a return of hemorrhage, and rendered it the more dangerous, as its suppression was now more difficult than before the cautery had been applied. Sometimes the instrument, being too much heated, immediately brought away with it the eschar. At the present time, the cautery is never employed, as a means of suppressing hemorrhage, or, at most, only in a few very unusual cases, in which neither compression nor the ligature can be made use of. In Great Britain, the cautery is never employed, except in circumstances of this description; but, in France, the best hospital surgeons now and then employ it to stop bleedings from the anus, antrum, and mouth.

The old surgeons very commonly applied to bleeding parts pledgets, dipped in boiling turpentine,—a practice that has long been most justly abandoned.

Astringents, Styptics, &c.

Le Dran says, that a button of vitriol, or alum, applied and properly confined on the extremity of the vessel, is sufficient to stop the hemorrhage in amputations. Heister recommends the application of vitriol, in preference to the ligature, in the amputation of the fore-arm. Great praises have also been conferred on agaric, and sponge, for their styptic properties. Solutions of iron, and all the mineral acids in various forms, have been recommended to the public, as remedies of the same kind, and possessing great efficacy. The ancients, centuries ago, left no application of this nature untried, and the pretended discoveries of new and more effectual styptics in later times, may almost all be met with in their writings. This fact merits particular notice, because the little success attending their practice, especially when bleeding from a considerable artery was to be suppressed, clearly proves what little reliance ought to be placed on means of this description. (*Encyclopédie Méthodique, Partie Chir.*) The most which styptics can do, is to stop hemorrhages from small arteries; but, they ought never to be trusted when large vessels are concerned.

There is no doubt that cold air has a styptic property; by which expression, I mean, that it promotes the contraction of the vessels; for no styptics can contribute to make the blood coagulate, though such an erroneous idea is not uncommon. We frequently tie, on the surface of a wound, every artery, that betrays the least disposition to bleed, so long as the wound continues exposed to the air. We bring the opposite sides of this wound into contact, and put the patient to bed. Not an hour elapses, before the renewal of hemorrhage compels us to remove the dressings. The wound is again exposed to the air, and again the bleeding ceases. This often happens in the scrotum, after the removal of a testicle, and on the chest, after the removal of a breast. The proper conduct, in such cases, is not to open the wound unnecessarily, but to apply pressure, or else wet linen, to the part, so as to produce such an evaporation from its surface, as shall create a sufficient degree of cold to stop the bleeding. As all styptics are more or less irritating, no judicious practitioners apply them to recent wounds. However, for the suppression of hemorrhage from diseased surfaces, where the vessels seem to have lost their natural disposition to contract, these applications are sometimes indicated.

Compression.

We have already remarked, that all the best means of checking hemorrhage operate on the principle of pressure; the actual and potential cautery, and some styptics excepted: the two first of which act by forming a slough, which stops up the mouths of the vessels; while the latter operate by promoting their contraction. Let us next consider the various modifications of pressure.

In a dissertation on the manner of stopping hemorrhage, printed in the *Mém. de l'Acad. de Sciences, année* 1731, Petit endeavoured to prove, that different articles, praised as infallible specifics, would seldom, or never, have succeeded without compression. Even when caustics were employed, it was usual to bind compresses tightly on the part, so as to resist the impulse of the blood in the artery, and the premature separation of the eschar. Had this precaution not been taken, Petit believes, that hemorrhage would almost invariably have followed; and, indeed, notwithstanding the pains taken to avert it by suitable compression, it did too frequently take place on the detachment of the eschar. Petit has noticed, that the end of a finger, gently compressing the mouth of a vessel, is a sufficient means of stopping hemorrhage from it, and that nothing else would be necessary, if the finger and stump could always be kept in this posture. Hence he endeavoured to obviate these difficulties by inventing a machine which securely and incessantly executed the office of the finger. The instrument was a double tourniquet, which, when applied, compressed, at once, both the extremity of the divided artery and its trunk above the wound. The compression on the end of the vessel was permanent; that on the trunk was made only at the time of dressing the wound, or when it was necessary to relax the other. An engraving and particular description of the instrument are to be found in Petit's memoir.

Surgeons formerly filled the cavities of wounds with lint, or charpie, and then made pressure on the bleeding vessels, by applying compresses and a tight roller over the part. The practitioners of the present day are too well acquainted with the advantages of not allowing any extraneous substance to intervene between the opposite surfaces of a recent wound to persist in the above plan. They know, that the sides of the wound may be brought into contact, and that compression may yet be adopted, so as both to restrain particular hemorrhages, and rather promote, than retard, the union of the wound.

When the blood does not issue from any particular vessel, but from numerous small ones, compression is preferable to the ligature. In the employment of the latter, it would be necessary to tie the whole surface of the wound. The sides of the wound are to be brought accurately together, and compresses are then to be placed over the part, and a roller to be applied with sufficient tightness to make effectual pressure, but not so forcibly as to produce any chance of the circulation in the limb being completely stopped.

If, in bleeding from large arteries, compression can ever be prudently tried, it is when these vessels lie immediately over a bone. Bleedings from the radial and temporal arteries are generally cited as cases of this kind, though, from the many instances of failure, which I have seen happen where the first of these vessels is concerned, I should be reluctant either to advise or make such an attempt. Compression is sometimes tried, when the brachial artery has been wounded in phlebotomy. Here it is occasionally tried, in preference to the ligature, because the latter cannot be employed without an operation to expose the artery.

"When the brachial artery has been wounded, in bleeding at the bend of the arm (says Mr. Crosse,) I find so many instances narrated of successful management by pressure, that it seems imperative on us to regard this as the general rule of treatment. Sometimes the artery has been extensively obliterated by the pressure employed; at others, the same change has taken place in the vein; and one example is afforded of the aperture between the artery and the vein closing, each vessel remaining pervious after the cure. Pressure is, however, applicable only where a competent surgeon has the opportunity of employing it soon after the injury" (*J. G. Crosse*, in *Prov. Med. and Surgical Trans.*, vol. v.); and, I would add, while the quantity of blood, effused in the cellular tissue, is not such as to interfere with its operation, or to render the trial of it likely to bring on mortification.

When there is a small wound in a large artery, the following plan may be tried: a tourniquet is to be applied, so as to command the flow of blood into the vessel; the edges of the external wound are next to be brought into contact: then, a compress, shaped like a blunt cone, and which is best formed of a series of compresses, gradually increasing in size, is to be placed with its apex exactly on the situation of the wound in the artery. This *graduated compress*, as it is termed, is then to be bound on the part with a roller.

In this manner, I once healed a wound of the superficial palmar arch, in a young lady in Great Pulteney-street. The outward wound was very small; and though the hemorrhage was profuse, I conceived, that it might be permanently stopped, if compression could be so made as to keep the external wound incessantly and firmly covered for the space of a day or two. At first I tried a compress of lint, bound on the part with a roller; but this proving ineffectual, I took some pieces of money, from the size of a farthing to that of a half-crown, and, wrapping them up in linen, put the smallest one accurately over the wound, so as completely to cover it. Then the others were arranged, and all of them were firmly confined with a roller, and the arm kept as quiet as possible in a sling. They were taken off after three days, and no hemorrhage ensued.

When the palmar fascia is not freely cut, it is conceivable, that it might prevent compression from operating on the vessel; but the foregoing case shows, that a wound of the superficial palmar arch is capable of healing, if the blood be completely prevented from getting out of the external wound by the proper application of compression. Were the outer wound free and open, it would be the safest practice to take up the ends of the vessel. Mr. Crosse, of Norwich, in more than one or two instances, has succeeded in tying the palmar arch when wounded, and would always *first* attempt it, going to another resource only when that had failed, or swelling and inflammation prevented it. He thinks it would be going a great length, to put a ligature on the brachial artery for a wounded palmar arch. (*Op. et* vol. cit.) Sometimes tying the ulnar artery has failed; but, under these circumstances, instead of tying the brachial artery, if the state of the wound would not bear pressure, I should prefer the trial of moderate compression of the radial artery, by means of a graduated compress, or the steel semicircle and screw, occasionally resorted to by Dupuytren, when he wished to check the flow of blood through any particular artery, without stopping the circulation in the limb. I feel confident that this plan would answer, when the ligature of the ulnar artery had not sufficiently commanded the bleeding.

Besides compressing the wounded part of the artery, some surgeons also apply a longitudinal compress over the track of the vessel above the wound, with the view of weakening the flow of blood into it. Whatever good effect it may have in this way, is more than counterbalanced by the difficulty which it must create to the circulation in the arm. If the graduated compress be properly arranged, an effusion of blood cannot possibly happen, and pressure along the course of the artery must, at all events, be unnecessary. After relaxing the tourniquet, if no blood escape from the artery, the surgeon (supposing it to be the brachial artery wounded) should feel the pulse at the wrist, in order to ascertain, that the compression employed is not so powerful as entirely to impede the circulation in the fore-arm and hand. The arm is to be kept quietly in a sling, and in forty-eight hours, if no bleeding take place, there will be great reason to expect that the case will do well. In another work, I have given an engraving and description of an instrument, invented by Plenck, for making pressure on the wounded brachial artery, at the bend of the arm, without pressing upon the whole circumference of the limb, and, consequently, without stopping the circulation. No one, however, would prefer compression when large arteries are injured, except in the kind of cases, to which we have just now adverted, or in those in which the wounded vessel can be firmly compressed against a subjacent bone. Sometimes the compresses slip off, or the bandages become slack, and a fatal hemorrhage may arise; and a still greater risk is that of mortification from the constricted state of the limb. When the method is tried, the tourniquet should always be left loosely round the limb, ready to be tightened in an instant. Sometimes the external wound heals, while the opening in the artery remains unclosed, and a false aneurism is the consequence.

Tourniquet.

At the present day, the means for the temporary stoppage of the flow of blood through the arteries in operations, are reducible to two, viz., pressure, and, in a few instances, the preliminary application of a ligature on the trunk of the vessels expected to bleed in a dangerous degree. Pressure is made either with mechanical instruments or the hand. In amputations, M. Dupuytren rarely employed any other means but the hand of an intelligent assistant; and it was only in special cases that he had recourse to the ligature or mechanical pressure. The same rule is adopted by Mr. Liston in University College Hospital; and I sometimes dispense with the tourniquet myself. Two conditions are necessary to render pressure effectual, whether made with an instrument, or the hand; the superficial situation of the artery, and its position upon a bone, or some other part sufficiently unyielding to admit of the vessel being pressed against it. (See *Dupuytren*, *Clin. Chir.* t. iv. p. 377.)

M. Dupuytren confirms, what every experienced operator is well aware of, namely, the fact of the flow of blood through the larger arteries admitting of being commanded by means of moderate pressure. But, this must be made with precision, and perpendicularly to the surface, which serves as a point of resistance. The inclination of the surfaces of the bones on which the vessels lie, should therefore be recollected. For example, that of the upper surface of the horizontal branch of the os pubis faces upwards and forwards, and that of the first rib upwards and slightly outwards. Consequently, in the groin, the pressure should be directed from above downwards, and from before backwards; and in the hollow, above the clavicle, from above downwards, and from without inwards. If the operation about to be performed is likely to be long, or the artery is large or rather deep, M. Dupuytren recommends the assistant to place the fingers of his unemployed hand over those which compress the vessel, in order to second their action, and hinder them from being fatigued. But, before beginning the operation, the surgeon is always to assure himself of the exactness of the pressure. In some regions of the body, and in thin persons, the diastole and systole of the vessel are perfectly visible, and then the stoppage of them denotes, that the pressure is well made. The total interruption of the pulsations, as ascertained by the touch, will leave no doubt on this point. There are some amputations, in which every modification of pressure may be dispensed with, even though arteries of great size are concerned: such are cases, in which the principal artery will be cut only in the final division of the parts, and in which an assistant, who can be relied upon, will let his fingers follow closely the knife, and seize hold of the flap containing the artery, and compress this vessel just before the section of the flap is completed. This method is practicable in amputations at the shoulder, and even in those of the hip. M. Dupuytren knew of only one case, in which the preliminary ligature of the artery was absolutely necessary in amputation, viz., that in which the disorganisation of parts, and of the artery in particular, is such, that a definitive ligature on the surface of the stump would in all probability fail. In this circumstance he sanctions tying the arterial trunk above the point at which the amputation is to be performed. (See *Clin. Chir.* t. iv. p. 382. 385.) I would ask, however, should this measure be preliminary, or ought it not rather to be deferred till the failure of the ligature on the face of the stump has been proved? The performance of two severe operations, instead of one, must never be undertaken without a positive necessity. Most of the preliminary operations on the trunks of arteries, hitherto performed for the prevention of hemorrhage during amputations, and in the removal of the upper or lower jaw, are now considered to have been unnecessary. In England, we should never amputate in parts known beforehand to be so disorganised, that ligatures would have no chance of securing the vessels on the face of the stump.

When hemorrhage takes place from a large artery in one of the limbs, where the vessel can be conveniently compressed above the wound, a tourniquet, judiciously applied, never fails to put an immediate stop to the bleeding. Until the invention of this instrument, which did not take place till the latter part of the 17th century, and until it was known that a very moderate degree of well-directed pressure on an artery would stop profuse bleeding, surgery was really a very defective art. No important operation could be undertaken on the extremities, without placing the patient in the most imminent peril; and many wounds were mortal, which, with the aid of these simple expedients, would not have been attended with the least danger.

The first invention of the tourniquet has been claimed by different surgeons, and even different nations. But, whoever was the inventor, it was first presented to the public in a form so exceedingly simple, that it seems extraordinary its invention did not happen sooner. A small pad being placed on the principal artery of a limb, a band was applied over it, so as to encircle the limb twice. Then a stick was introduced between the two circles of the band, which was twisted; thus the pad was made to stop the flow of blood into the lower part of the vessel.

Although in the *Armamentarium Chirurgicum* of Scultetus, there is a plate of a machine invented by this author for compressing the radial artery by means of a screw, J. L. Petit is universally allowed to be the first who brought the tourniquet to perfection, by combining the circular band with a screw, so that the greatest pressure may operate on the principal artery.

The advantages of the modern tourniquet are, that its pressure can be regulated with the utmost exactness; that it operates chiefly on the point where the pad is placed, and where the main artery lies; that it does not require the aid of an assistant to keep it tense; that it completely commands the flow of blood into a limb; that it can be relaxed or tightened in a moment; and that, when there is reason to fear a sudden renewal of hemorrhage, it can be left slackly round the limb, and, in case of need, be tightened in an instant. Its utility, however, is confined to the limbs; and, as the pressure, necessary to stop the flow of blood through the principal artery, completely prevents the return of blood through the veins, its application cannot be made very long without inducing mortification. It is only of use, also, in putting a sudden stop to profuse hemorrhages for a time, that is, until the surgeon has put in practice some other means, the effect of which is more permanent.

In the article Amputation, many observations will be found on the advantages and disadvantages of tourniquets in that operation. M. Dupuytren sometimes employed, instead of a common tourniquet, what he terms a *compressor*, which makes pressure only on two opposite points of the limb; but, as he acknowledges, it would not be sufficient, if it were necessary, as in a case of extreme debility, to arrest the blood in all the arteries of the limb. (See *Clin. Chir.* t. iv. p. 386.) The compressor is an old instrument, consisting of a segment of a circle of steel, and the pressure of which is regulated by a screw. It has often been tried in England for the cure of popliteal aneurism. It is an instrument, which, I think, ought always to be kept ready in hospitals, where many cases present themselves, especially of secondary hemorrhage from stumps, the palmar arches, &c., where its application might be of important use. Professor Regnoli, of Pisa, in a case of aneurism, where secondary hemorrhage took place from the femoral artery, high up the limb, and where, in consequence of disease, another ligature would probably have failed, applied Dupuytren's compressor, and thus made moderate pressure on the bleeding point, with complete success.

Ligature.

The ancients were quite unacquainted with the use of the tourniquet; and though some of their writers have made mention of the ligature, they do not seem to have known how to make proper use of it, nor to have possessed any other certain means of suppressing hemorrhage from wounds. In modern times, it is easily comprehensible, that when any great operation was undertaken, while surgery was so imperfect, there was more likelihood of the patient's life being shortened, than lengthened by what was attempted. Under these circumstances, it is not surprising, that the old practitioners should have taken immense pains to invent a great many topical astringents. But now that the ligature is known to be a means which is safer, and less painful, than former methods, no longer search need be made for specifics against hemorrhage.

It may, indeed, be set down as a rule in surgery, that whenever large arteries are wounded no styptic application should ever be employed; but immediate recourse had to the ligature, as being, when properly applied, the most simple and safe of all methods.

In order to qualify the reader to judge of the best mode of applying ligatures to arteries, I shall first explain to him their effects on these vessels, as related by Dr. Jones.

This gentleman learned, from Dr. J. Thomson, of Edinburgh, that, in every instance in which a ligature is applied around an artery, without including the surrounding parts, the internal coat of the vessel is torn through by it; and that this fact had been originally noticed by Desault. Dr. Thomson even demonstrated to Dr. Jones, on a portion of artery taken from the human subject, that the internal and middle coats are divided by the ligature. (*Jones*, p. 126.)

This led Dr. Jones to make some experiments on the arteries of dogs and horses, tending to the conclusion, that *when several ligatures are applied round an artery,* with sufficient tightness to cut through its internal and middle coats, although the cords be immediately afterwards removed the vessel will always become impervious at the part which was tied, as far as the first collateral branches, above and below the obstructed part. Dr. Jones thinks it reasonable to expect, that the obstruction produced in the arteries of dogs and horses, in the manner he has related, "might be effected by the same treatment in the arteries of the human subject; and, if it should prove successful, it might be employed in some of the most important cases in surgery. The success of the late important improvements, which have been introduced in the operation for aneurism, may perhaps appear to most surgeons to have rendered that operation sufficiently simple and safe; but, if it be possible to produce obstruction in the canal of an artery of the human subject in the above-mentioned manner, may it not be advantageously employed in the cure of aneurism, inasmuch as nothing need be done to prevent the immediate union of the external wound?" Dr. Jones next questions, whether this mode of obstructing the passage of blood through the arteries may not also be advantageously practised in cases of bronchocele? (P. 136.)

Subsequent experimenters have not been equally successful with Dr. Jones in obtaining the obliteration of the cavity of the vessel after this operation. Did this difference depend upon their having tied the vessel only in one place? Mr. Hodgson tried the experiment in two instances upon the carotid arteries of dogs, and in neither of them was the cavity of the vessel obliterated. The same experiment has been repeated by several surgeons upon the arteries of dogs and horses; but in no example, as far as Mr. Hodgson knows, has the complete obliteration of the cavity of the vessel been accomplished. However, as an effusion of lymph is an invariable consequence of the operation, the want of union is owing to the opposite sides of the vessel not being retained in a state of contact, so as to allow of their adhesion. (See *Obs. on the Application of the Ligature to Arteries, &c., by B. Travers,* vol. iv. *Med. Chir. Trans.*) The presence of the ligature, in the common mode of its application, effects this object; and, for the success of Dr. Jones's experiment, it appeared only necessary, that the opposite sides of the wounded vessel should be retained in contact, until their adhesion had been sufficiently accomplished to resist the passage of the blood through the tube. This object might probably be effected by compression; but, the inconveniences attending such a degree of pressure, as would retain the opposite sides of an artery in contact at the bottom of a recent wound, are too great to permit its employment. It occurred to Mr. Travers, that, if a ligature were applied to an artery, and suffered to remain only a few hours, the adhesion of the wounded surfaces would be sufficiently accomplished to ensure the obliteration of the canal; and by the removal of the ligature at this period, the inconveniences attending its stay would be obviated. The danger, produced by the continuance of a ligature upon an artery, arises from the irritation, which, as a foreign body, it produces in its coats. Ulceration has never been observed to commence in less than twenty-four hours after the application of a ligature; whilst it is an ascertained fact, that lymph is in a favourable state for organisation in less than six hours, in a wound the sides of which are preserved in contact. (*Jones*, chap. 4. exp. 1.) If it be sufficient, therefore, to ensure their adhesion, that the wounded coats of an artery be kept in contact by a ligature only three or four hours, ulceration and sloughing may, in a great degree, be obviated by promoting the immediate adhesion of the wound. Justified by this reasoning, Mr. Travers performed several experiments, by which he ascertained, that if a ligature be kept six, two hours, or even one hour, upon the carotid artery of a horse, and then removed, the adhesion is sufficiently advanced to secure the permanent obliteration of the canal. It appeared probable, that the same result would be obtained upon the healthy artery of a human subject. (*Hodgson on the Dis. of Arteries, &c.* p. 228. et seq.) Mr. A. C. Hutchison, in the year 1800, tied the brachial arteries of two dogs, and removed the ligatures immediately after their application. In both instances, the complete obliteration of the canal of the artery was the consequence of the operation. (See *Practical Obs. in Surgery*, p. 103.) He has also tried this method, as modified by Mr. Travers, in an operation, which he performed for a popliteal aneurism in a sailor, in Nov. 1813. A double ligature was passed under the femoral artery. The ligatures were tied with loops, or slip-knots, about a quarter of an inch of the vessel being left undivided between them. All that now remained of the pulsation in the tumour, was a slight undulatory motion. Nearly six hours having elapsed from the application of the ligatures, the wound was carefully opened, and the ligatures untied and removed, without the slightest disturbance of the vessel. In less than half a minute afterwards, the artery became distended with blood, and the pulsations in the tumour were as strong as they had been before the operation. Mr. Hutchison then applied two fresh ligatures: hemorrhage afterwards came on, amputation was performed, and the patient died. (See *Pract. Obs. in Surgery*, p. 102, &c.) Now, as Mr. Hutchison chose to apply other ligatures, on finding that the pulsation returned, the above case only proves, that the artery was not obliterated in about six hours; and we are left in the dark respecting the grand question, namely, whether the vessel would have become obliterated by the effusion of coagulating lymph and the adhesive inflammation, notwithstanding the return of circulation through it. As for the hemorrhage which occurred, I think it might have been expected, considering the disturbance and irritation which the artery must have sustained, in the proceedings absolutely necessary for the application of not less than four ligatures, and the removal of two of them. According to my ideas, only one ligature ought to have been used, and none of the artery detached. We also have no description of the sort of ligatures which were employed; an essential piece of information in forming a judgment of the merits of the preceding method. The application, removal, and re-application of ligatures are not consistent with the wise principles inculcated by the late Dr. Jones, and have, in more instances than that recorded by my friend, Mr. Hutchison, brought on ulceration of the artery and hemorrhage. The researches of M. Manec lead him to conclude, with all the best practical surgeons of the present time, that the removal of the ligature at an earlier period, than that of its spontaneous detachment, is not likely to answer. He observes, that "the continuance of the ligature on the artery, for some hours after the division of the internal and middle coats, is not sufficient in man to produce its closure. The plan succeeds but seldom in animals, dogs, for instance, whose blood is more plastic. On one hand, the adhesion of the parietes of the artery together is so feeble, for the first five or six hours after the operation; and, on the other, the clot is so small, that the impulse of the blood, and the disturbance of extracting the thread, will destroy one, and displace the other." (See *P. J. Manec, de la Ligature, &c.* p. 30.) If ever the practice, however, should merit revival, I invite the attention of the profession to the simple invention proposed by Mr. John Barker, of Ipswich, for loosening and removing the ligature. See Aneurism.

It appears, then, that the first effects of a ligature upon an artery are, a complete division of its internal and middle coats, the bringing of its wounded surfaces into contact with each other, and an obstruction to the circulation of the blood through its canal. There must be a small quantity of stagnant blood, just within the extremity of the artery; but this does not, in every instance, immediately form a coagulum, capable of filling up the canal of the artery. In most cases, only a slender coagulum is formed at first, which gradually becomes larger by successive coagulations of the blood; and hence the coagulum is always at first of a tapering form, with its base at the extremity of the artery. But, as Dr. Jones remarks, the formation of this coagulum is not material; for, soon after the ligature has been applied, the end of the artery inflames, and the wounded internal surface of its canal, being kept in close contact by the ligature, adheres, and converts this portion of the artery into an impervious, and, at first, slightly conical sac. It is to the effused lymph that the base of the coagulum adheres, when found to be adherent. Lymph is also effused between the coats of the artery, and among the parts surrounding its extremity. In a little time, the ligature makes the part, on which it is directly applied, ulcerate; and, acting as a tent, a small aperture is formed in the layer of lymph effused over the artery. Through this aperture a small quantity of pus is discharged, as long as the ligature remains; and, finally, the ligature itself also escapes, and the little cavity which it has occasioned granulates and fills up, and the external wound heals, leaving the cellular substance, a little beyond the end of the artery, much thickened and indurated. (*Jones*, p. 159. 161.)

In short, when an artery is properly tied, the following are the effects.

1. The first action of the ligature is to pucker up, and press towards one another the parietes of the artery, and, after they touch, if the ligature is further tightened, the internal and middle coats of the vessel are cleanly and regularly cut through; while the external coat, which, by being forcibly constricted by the ligature, has been the direct means of producing this division, resists the action of the ligature, and becomes interposed between the upper and lower margins of the wound in the other coats of the artery. Thus the ligature now only embraces the external coat, the two divided ones being retracted, one towards the heart, the other towards the capillaries. Hence, the cavity of the artery has a conical shape, above and below the ligature, and the points of these cones, formed by the edges of the division in the internal and middle coats, which are in opposition, hinder the blood from passing further, and striking against the external coat. As M. Manec observes, the whole operation of the ligature must be concentrated on this point; and the margins of the wound, in the middle and internal coats, are only held in contact, inasmuch as the external tunic presses upon them, and inclines them towards the centre of the artery. This pressure, which is sufficient to close the calibre of the vessel, does not interrupt the vital properties of these two coats; but the external coat, on which the ligature exclusively acts, is killed at the constricted point, and a suppurative, or, rather, an ulcerative, process must occur in this situation, in order to detach the dead circle of this external coat from the living parts, together with the ligature itself. Thus all the artery becomes severed; the internal and middle coats first; the external at a later period. (See *Manec, de la Ligature des Artéres*, p. 14).

2. Another effect is to occasion a determination of blood to the collateral branches.

3. To allow the formation of a coagulum of blood just within the artery, provided a collateral branch be not very near the ligature. It merits particular notice, however, that, though the nearness of a collateral branch always prevents the formation of the coagulum, it cannot always prevent the completion of the adhesive process. In the experiments, made on the arteries of horses and dogs by Mr. Travers, the ligature was purposely applied close to large collateral branches, yet the vessels were safely obliterated. (See *Med. Chir. Trans.* vol. vi. pp. 658. 660.)

4. To excite inflammation in the internal and middle coats of the artery, by having cut them through, and, consequently, to give rise to an effusion of lymph, by which the wounded surfaces are united, and the canal is rendered impervious; to produce a simultaneous inflammation on the corresponding external surface of the artery, by which it becomes very much thickened with effused lymph; and, at the same time, from the exposure and inevitable wounding of the surrounding parts, to occasion inflammation in them, and an effusion of lymph, which covers the artery, and forms the surface of the wound.

5. To produce ulceration in the part of the artery, around which the ligature is immediately applied, viz., its external coat.

6. To produce indirectly a complete obliteration, not only of the canal of the artery, but even of the artery itself, to the collateral branches on both sides of the part which has been tied.

7. To give rise to an enlargement of the collateral branches. (*Jones*, p. 163, 164.)

Every part of an artery is organised in a similar manner to the other soft parts, and its coats are susceptible of the same processes of adhesion, ulceration, &c., as the latter parts are. Hence, the precautions, taken to secure the adhesion of other parts, should be observed for the same purpose, with regard to an artery. The vessel is put in a state to admit of adhesion by the ligature, which, when properly applied, cuts through its internal and middle coats, keeps their cut surfaces in contact, and affords them an opportunity of uniting by the adhesive inflammation, as other cut surfaces do. The immediate stoppage of the bleeding is merely the incipient and temporary part of what the ligature has to accomplish: it has also to effect the adhesion of the internal and middle coats of the artery, which, being the thing on which the permanent suppression of hemorrhage depends, is the most important. The size and form of the ligature, whether completely flat, or irregular, have not been, as Dr. Jones remarks, sufficiently attended to; nor is the degree of force employed in tying the artery often considered. Some surgeons, wishing to guard against the ligature slipping off, tie it with very considerable force; while others, apprehensive of cutting through the artery, or of occasioning too early a separation of the ligature, draw it only sufficiently tight just to prevent the escape of blood. A broad flat ligature is not likely to make such a wound in the internal and middle coats of the artery as is most favourable to adhesion, because it is scarcely possible to tie it smoothly round the vessel, which is very likely to be thrown into folds, or puckered by it, and, consequently, to have an irregular bruised wound made in its middle and internal coats. By covering, also, a considerable space of the external coat, it may destroy the very vessels which pass on it in their way to the cut surfaces of the inner coats, and thus render them incapable of inflaming. Even supposing the wound to unite, still such a ligature may cover that part of the external coat which is directly over the newly united part, and, consequently, as soon as it has produced ulceration through the external coat, it will cause the same effect on the newly united parts, and, of course, secondary hemorrhage. (*Jones*, p. 168.)

When a ligature is of an irregular form, it is apt to cut through the internal and middle coats of an artery more completely at some parts than at others; but these coats ought to be perfectly cut through, in order to produce an effusion of fibrine from the inside of the vessel, which seems to adhere most securely at its cut surfaces.

Also, when the ligature is not applied with sufficient tightness, the inner coats of the artery will not be properly cut through. Dr. Jones thinks, that the ligature being sometimes put on so as to deviate from a circle, has a tendency to produce secondary hemorrhage.

Dr. Jones conceives that ligatures are best when they are round and very firm; and he adds, that, though only a slight force is necessary to cut through the internal and middle coats of an artery, it is better to tie the vessel more tightly than is necessary merely to cut through its inner coats, because the cut surfaces will thus be more certainly kept in contact, the separation of the ligature expedited, and the danger of ulceration spreading to the newly cicatrised part diminished. The external coat will never ulcerate through before the inner ones have adhered. The limb, however, should be kept in a perfectly quiet state.

I am sincerely glad to find, that so accurate an observer as Dr. Jones has refuted the idea, that ligatures occasionally slip off the vessels, in consequence of the violent impulse of the blood. In fact, the blood does not continue to be impelled against the extremity of the artery with the same impetuosity with which it circulated through the vessel before it was tied. The blood is immediately determined into the collateral branches, nor is there any pulsation for some way above the ligature. Dr. Jones, more rationally, imputes this accident, either to the clumsiness of the ligature, which prevents its lying compactly and securely round the artery; or to its not having been applied with sufficient tightness; or to its having that very insecure hold of the vessel which the deviation from the circular application must occasion. (P. 173.)

Another circumstance, adverted to by Dupuytren, may cause the accident:—" The surgeon," says he, " should avoid taking hold of only one side of the artery by placing one blade of the forceps into its canal; for, it has sometimes happened that, when only a part of the circumference of the artery has thus been included in the noose, hemorrhage has come on directly the wound has been dressed." (See *Clin. Chir.* t. iv. p. 399.)

Dr. Jones is of opinion, that in cases of aneurism, in which the artery has only been tied with one ligature, and left undivided, and in which secondary hemorrhage has arisen, that this has most probably been owing, either to a diseased state of the artery; to various contrivances for compressing a large portion of the vessel; to having a loose ligature above the one which is tied; or, lastly, to not tying the artery sufficiently tight to cut through the internal and middle coats, so as to fit them for adhesion. The latter fault can hardly fail to produce a gradual ulceration of those coats, and, of course, to bring on hemorrhage, which returns with greater violence, as the ulceration advances. (P. 176.)

These reflections must also obviously explain why Scarpa's practice of using a largish ligature, with the intervention of a piece of cloth between the cord and the vessel, for the express purpose of hindering the inner coats of the vessel from being divided, must be objectionable, because it may be set down as an axiom, in all operations where large arteries are to be tied, that the quantity of extraneous substances in the wound, and particularly of such as are in contact with the artery, should be diminished as much as possible. And, though I may be disposed to go so far with Scarpa as to believe, that the interposition of a piece of cork or wood is worse than that of a cylinder of linen, I cannot accede to the proposition, that the latter is free from objection, because it rather acts as a cushion than as a body likely to bruise. (See *Mem. on the Ligature of Arteries*, p. 44.)

With the differences in the constitutions of man and animals, I know that the results of experiments on the latter can never be looked upon as a positive proof of what would happen from the same experiments performed on the human subject. The stronger or weaker impulse of the heart, the more or less coagulable nature of the blood, the greater or less degree of general and local irritability, the more or less quick tendency to adhesive inflammation and ulceration, are circumstances, which must make in different animals the same experiments lead to opposite results. The question, whether a small round ligature or a larger flat one, with a piece of linen between it and the vessel, be best, must therefore, after all, be decided, not by Dr. Jones's experiments, nor those of Scarpa or Mislei, but by the practice of surgery on the human body; and that the principles defended in this Dictionary are, on the whole, to be preferred, can hardly be questioned by any man who knows how much less frequent secondary hemorrhage now is in this metropolis than it was formerly, when those principles were neither observed nor comprehended. (See Amputation, Aneurism, Arteries, and Ligature.)

We may next inquire, are small round ligatures most advantageous when arteries are ossified? M. Manec states, that, under these circumstances, such a ligature will break the calcareous and cartilaginous deposits into irregular fragments, so that the external coat, instead of making moderate and uniform pressure on the section of the middle and internal tunics, is distended and violently pushed up by the irregular edges of each fragment. At one of these points, the external coat is likely to give way between the second and fourth day. M. Manec further notices the greater difficulty and slowness with which the exudation of a plastic lymph, the exhalation of an unctuous matter, and the formation of a clot, in an artery thus diseased and tied, occur, than in a healthy artery similarly treated. These considerations lead him to join Boyer, (*Mal. Chir.* t. ii. pp. 139. 155.) in deeming small, round, firm ligatures, or even those which are composed of three or four threads, as improper for ossified arteries; he states, that they ought to be rejected, because they too quickly cut through the external coat. In these particular examples, he expresses a preference to arterial compressors (*presse-artères*), or to Scarpa's method, care being taken not to let the pressure, or constriction, be too considerable. In amputations, cases in which ossified arteries are frequently met with, M. Manec admits the unfitness of any arterial compressors, on account of their irritation and interference with the dressing of the stump. In these instances, therefore, he says, that either Scarpa's method, or, what is better, the introduction of a piece of bougie into the ossified artery, as practised by MM. Dupuytren and Roux, is the only resource. (See *P. J. Manec, de la Ligature, &c.* p. 25.) One inference made by him is, that when an artery is ossified or cartilaginous, the formation of a clot is the only thing which can be confided in as a means of closing the vessel. (P. 30.)

Dr. Jones seems to consider, that the advantage of the retraction of the *divided* artery within the cellular tissue is compensated, in the case of the *undivided* artery, by the speedy and profuse effusion of lymph which takes place over and round the vessel at the tied part, and even covers the ligature itself. Another cause of secondary hemorrhage is the including of other parts in the ligature, together with the artery, by doing which the division of the inner coats of the vessel may be prevented.

In the valuable publication of Dr. Jones, to which I have so freely adverted, some secondary hemorrhages are also imputed to the hidden separation, or laceration, of the recently united parts of an artery by premature and extraordinary exertions of the patient. Hence the necessity for keeping a limb, in which a large artery has been tied, perfectly at rest.

I shall conclude these remarks on the ligature with a few practical rules.

1. Always tie a large artery as separately as possible, but still let the ligature be applied to a part of the vessel which is close to its natural connections.

Besides the reasons for this practice already specified, I may observe, that including many other living textures in the ligature causes immense pain, and a larger part of a wound to remain disunited. The ligature is also apt to become loose as soon as the substance between it and the artery sloughs or ulcerates. Sometimes the ligature, thus applied, forms a circular furrow in the flesh, and remains a tedious time incapable of separation. In particular, the surgeon should take great care not to include in the ligature considerable nerves or veins: "intolerable pain, and, frequently, very serious effects, would immediately follow the constriction of a nervous trunk. Tying large veins does not produce any instantaneous bad symptoms; but it has often led consecutively to phlebitis, and been followed by symptoms which have too often proved fatal." (*Dupuytren, Clin. Chir.* t. iv. p. 399.)

The blood-vessels being organised like other living parts, the healing of a wounded artery can only take place favourably, when that part of the vessel, which is immediately contiguous to the ligature, continues to receive a due supply of blood through its vasa vasorum, which are ramifications of the collateral arteries. Hence, the disadvantage of putting a ligature round the middle of a portion of an artery, which has been separated from its surrounding connections; and hence, the utility of making the knot as closely as possible to that part of the vessel which lies undisturbed among the surrounding flesh.

Small arteries neither allow, nor require, these minute attentions to the mode of tying them.

2. When a divided artery is large, open-mouthed, and quite visible, it is best to take hold of it, and raise its extremity a little way above the surface of the wound, with a pair of forceps, or Assalini's double tenaculum. When the vessel is smaller, the common tenaculum is the most convenient instrument.

3. While the surgeon holds the vessel in this way, the assistant is to place the noose of the ligature round it, and tie it according to the above directions. In order that the noose may not rise too high, and even above the mouth of the artery, when it is tightened, the ends of the ligature must be drawn as horizontally as possible, which is best done with the thumbs. A knot is next to be made.

4. As ligatures always operate in wounds as extraneous bodies, and one half of each is sufficient for the removal of the noose when detached, the other should be cut off close to the knot and taken away.

As I have explained in the articles Amputation and the Ligature, trials have been made of the practice of cutting off both ends of the ligature close to the knot, with the view of diminishing, as far as possible, the quantity of extraneous substances in the wound.

Upon the whole, the plan is not, however, considered to be advantageous, because the portion of the ligature, left in the wound, whatever be the materials of which it is composed, is never absorbed, but gives rise to small abscesses, or even causes a fistulous opening in a stump, of which I lately saw an instance in University College Hospital. In this case, as the two ends of the ligature had been accidentally, and not intentionally, snipped off, the cause of the fistula was, for nearly a fortnight, unsuspected.

5. When a large artery is completely divided, two ligatures, — one to the upper, the other to the lower part of the vessel,— are commonly necessary, in consequence of the anastomosing branches conveying the blood very readily into the part of the artery most remote from the heart, as soon as the first ligature has been applied.

6. When a large artery is only punctured, and compression cannot be judiciously tried, the vessel must be first exposed by an incision, only a small opening being made in the sheath, and then a double ligature introduced under it, with the aid of an eye probe. One ligature is to be tied above, the other below the bleeding orifice, with due attention to the principles explained in this article and that on Aneurism.

7. Ligatures usually come away from the largest artery ever tied in about a fortnight, and from those of moderate size in six or seven days. When they continue attached much beyond the usual period, it is proper to draw them very gently every time the wound is dressed, for the purpose of accelerating their detachment. Great care, however, is requisite in doing this; for, as Dr. Jones remarks, as long as the ligature seems firmly attached, pulling it rather strongly must act, more or less, on the recently cicatrised extremity of the artery, which is not only contiguous to it, but is still united to that portion of the artery (the external coat) which detains the ligature. (*Jones*, p. 162.)

In particular individuals, there appears to be an extraordinary tendency to profuse hemorrhage from very slight injuries. An instance of this kind has been recorded by Mr. Blagden, where a fatal hemorrhage arose from the extraction of a tooth. The patient, who was twenty-seven years of age, had had a tooth extracted when a boy, in consequence of which operation the bleeding continued for twenty-one days, from the socket, before it ceased. A very slight cut on the head was also followed by an alarming bleeding, which could not be stopped by pressure, styptics, or the ligature, so that it became necessary to apply the kali purum, which succeeded. On his having another carious tooth taken out, a profuse bleeding followed, which resisted the effect of styptics, caustic, and every means adopted to stop up the socket. The actual cautery was tried in vain. The dangerous condition of the patient seemed to leave no other resource but that of tying the carotid artery, which was done by Sir Benjamin Brodie. But even this proceeding failed to suppress the hemorrhage, which proved fatal. (See *Med. Chir. Trans.*, vol. viii. p. 224. Lond. 1817.) Several instances are recorded, in which all the males of particular families had this hemorrhagic tendency, so that, whether the bleeding arose spontaneously, or from a wound, it could not be suppressed, and their lives were lost. (See *Dict. des Sciences Med.*, art. *Cas Rares ; London Med. Repository*, vol. iii. p. 60. ; *Krimer, Versüche einer Physiologie des Blutz*, p. 318. *Leipzig*, 1823. *Journal des Progrès, pour* 1828. vol. ii. *Revue Med.*, Oct. 1835. *Sanson, des Hemorrhagies Traum.*, p. 16, &c.) Sometimes this extraordinary disposition to hemorrhage is owing to an accidental cause, that is little suspected. Thus, in an example which happened in the practice of M. Dupuytren, a tumour was found in the right auricle, completely blocking up, and greatly dilating the superior vena cava, and extending into the jugular vein up the lower third of the neck : it also filled up the right subclavian vein. The patient, a young woman, lost fatal quantities of blood from the wound of the skin in venesection, and the socket of a tooth. The actual cautery, and all other means were tried in vain. (See *Sanson des Hemorrhagies Traumatiques*, p. 21.) A mechanical obstacle to the circulation, either situated in the heart, or blood-vessels, is noticed by Dr. Carswell, as one of the causes of hemorrhage; and besides solutions of continuity, he likewise enumerates as causes, a modification of the functions of the capillaries, as evinced in vicarious hemorrhage, and that from erectile tissue. Nor does he omit a diseased state of the blood, as exemplified in scurvy, and some forms of purpura, and typhus fever. (See *Carswell's Illustrations of the Elementary Forms of Disease, Fasc.* 6.) On the mode of stopping hemorrhage from the sockets of the teeth, the reader will find some remarks in the *Edin. Med. and Surg. Journ.* No. 58. p. 157.

Torsion.

As even the most considerable arteries, in cases of lacerated wounds, frequently do not bleed, in consequence of the violent extension of these vessels, and the change produced in the disposition of their tunics, the idea of stopping hemorrhage, by methodically twisting the end of the wounded arteries, led to trials of what is called *torsion*. The practice was first hinted at by Galen, and proposed in modern days by M. Amussat, in 1829, and, about the same period also, by MM. Velpeau and Thierry. (See *Sanson des Hemorrhagies*, p. 157.) After having ascertained, by experiments on animals, that torsion was capable of arresting hemorrhage from the femoral, brachial, and carotid, and other arteries of magnitude, M. Amussat tried the method on the human subject in amputation, castration, and the removal of the breast. In one case he adopted it after amputation at the shoulder joint. In none of these instances did any secondary hemorrhage arise; but union by the first intention was followed only in one of the cases referred to, viz., that of a child. In 1829, M. Lieber, surgeon to the new hospital at Berlin, tried the plan with equal success ; and, about the same period, it was had recourse to with success by Dr. Fricke, of Hamburgh, by MM. Rust and Dieffenbach, of Berlin, and by M. Schrader, of Dresden. On the other hand, in France, the practice of torsion proved unsuccessful after two amputations performed by Professor Delpech. As the patients did not die of secondary hemorrhage, perhaps their cases have nothing to do with the advantages or disadvantages of torsion. In the hospital of St. Louis, at Paris, however, torsion failed in five out of six cases of amputation. Baron Dupuytren, having been requested by the Institute to make a report of the merits of the plan, tried it in the Hôtel Dieu, and came to the conclusion, that *torsion may be safely applied to arteries of small calibre, but that it is imprudent to trust to it when they are of large size.* (See *Clin. Chir.* t. iv. p. 410.) In a certain number of instances, torsion of the arteries has been followed by extensive inflammation and abscesses in the sheath of the artery.

With regard to its increasing the chance of union by the first, inasmuch as no extraneous substance is left in the wound, experience has not proved, that it has any advantage over the ligature, (*Dupuytren*, vol. cit. p. 411.); and, as M. Manec's researches show, the process of torsion kills a small portion of the artery, and the little slough is, in point of fact, quite as much an extraneous substance as the ligature itself. (See *Traité Théorique et Pratique de la Ligature, &c.*; also *Sanson, Op.* cit. p. 161.) Torsion is practised in two modes; in one, which is termed by the French *torsion libre*, the end of the artery is taken hold of with a pair of forceps, gently drawn out, and twisted round from four to six or eight times according to its size. This is the plan adopted by M. Thierry, (*De la Torsion des Artères*, Paris, 1829,) and by Dr. Fricke ; but as it has been found sometimes to produce inflammation, extending along the coats of the vessel, and even to rupture a collateral branch, the plan, recommended by M. Velpeau, is mostly preferred in France. This gentleman takes hold of the end of the artery with a pair of forceps, having a groove or not, draws it out of the wound, and separates it from the surrounding tissues: then he takes hold of it near its base with a second pair of forceps, with which he fixes it, while with the first pair of forceps he performs the torsion, three or four times for small arteries, and eight for large ones. (*Sur la Cessation Spontanée des Hemorrhagies, &c.*, Paris, 1830.) Some improvements were made in the practice of torsion by M. Amussat. He prefers forceps with longish flat blades, and which admit of being kept firmly shut with a screw. He aims particularly at dividing the inner coats, at the base of the end of the artery, with his finger nail, or the second pair of forceps, and then pushes them away from the surface of the wound, as it were, into the vessel. The torsion then only affects the external coat. The artery is thus closed by a kind of double valve, or, rather, barrier; viz. that formed of the internal coats ; and another by the twisted external one.

In practising torsion, great care should be taken not to introduce one of the blades of the forceps into the mouth of the artery, for then all the three coats might be torn, and the bleeding not be stopped. (See *Dupuytren, Clin. Chir.*, t. iv. p. 405.)

We find, then, that torsion does not consist in merely twisting the end of the artery, but that the two internal coats are also to be separated from, and pushed back from, the external one by the manœuvres adopted. Then the torsion is of the external tunic.

As the twisted end of the artery sloughs, and necessarily excites some degree of suppuration, this fact seems to explain why torsion is not less objectionable than the ligature, as preventing union by the first intention. On the whole, I believe, that M. Dupuytren's report of it, above referred to, is as correct as it is concise. The ligature only interferes with union by the first intention in the part of a wound where it lies: the rest may still heal in this desirable manner.

The hemorrhage from the bites of leeches sometimes proves exceedingly obstinate, and instances of death from this cause have occasionally happened, particularly in children. When common methods fail, the plan has been recently tried of passing a fine sewing needle through the skin on one side of the wound, and then another through the skin on the opposite side, and next twisting some thread round the needles, so as to draw them together and close the bite. The experiment fully answered. (See *Lond. Med. Repository*, Jan. 1819, pp. 23—26.)

Though arterial hemorrhage in operations has received full attention, it must be acknowledged, with M. Dupuytren, that venous bleeding has not attracted due consideration. At the instant of the soft parts being divided, where the course of the blood has been suspended by compression, a profuse quantity of this fluid sometimes gushes from the wound. Inexperienced surgeons, alarmed by the circumstance, stop the operation, and, by deranging the compression already made, rather increase than lessen the bleeding. Here, according to Dupuytren, *the colour of the blood should guide the operator. If dark-coloured, it comes from the limb below the incisions*, and, as it will soon cease, is of no importance. But, in operating on parts abounding in veins, and in which the circulation has not been interrupted, the dark-coloured bleeding will sometimes go on, fill the wound, and hinder the operator's proceedings. This is often illustrated in laryngotomy and tracheotomy. In other instances, the blood flows out profusely from the large veins, which are divided, the patient turns pale, and seems as if he would perish on the operating table. Dupuytren observes, that the continuance of such hemorrhage depends more upon the patient suspending respiration than on the size of the veins, and the blood not being then able to pass through the lungs, makes its escape from the veins divided in the operation. Here it is inexpedient to apply ligatures; because if one set of veins were tied, another set would begin to bleed. But directly the patient has filled his lungs two or three times completely with air, by making full inspiration, the hemorrhage ceases. These precepts were never forgotten by Dupuytren, whenever he divided considerable veins, either in the trunk, face, neck, or upper part of the limbs. (See *Leçons Orales de Clinique Chir*. t. iv. p. 392.) It would appear, from the researches of M. Poiseuille, that the interruption of respiration only has influence on the portion of the venous system above the diaphragm. (See *Journ. Univ. Hebdom. de Médecine*, t. i. p. 289. et t. iii. p. 97. 8vo. Paris, 1830.) However this may be, the practical observations of M. Dupuytren are highly important with reference to venous hemorrhage in the extraction of fibrous tumours from the nose, or antrum tracheotomy, and all other operations in the anterior region of the neck, a region so abundantly provided with veins of all sizes. The long and deep inspirations, however, recommended for the suppression of venous bleedings, are suspected by M. Sanson to have had, in some instances, a share in promoting the entrance of air into the veins, particularly when one of those in the upper part of the body has been wounded, and, in consequence of its parietes being indurated, it gapes, as was once exemplified to M. Delpech, in the axillary vein. (*Clin. Chir. de Montpellier.*) The passage of air into the wounded veins, observed by Beauchêne, Dupuytren, Græfe, Mott, and Clemot, usually destroys the patient almost instantly, unless care be taken to place a finger over the wound in the vein, as was done by M. Clemot. (See *Sanson des Hemorrhagies Traumatiques*, p. 91.)

For additional information respecting hemorrhage, see Amputation, Aneurism, Arteries, Ligature, and Wounds.

Consult also *Petit*'s Mémoirs, among those of l'Acad. des Sciences for the years 1731, 1732—1735. *Morand*, Sur le Changement qui arrive aux Artères coupées, 1736. *Pouteau*, Mélanges de Chirurgie. *Gooch*'s Chirurgical Works, vol. i. *Kirkland*'s Essay on the Method of suppressing Hemorrhages from divided Arteries, 8vo. Lond. 1763. *White*'s Cases in Surgery. *J. Bell*'s Principles of Surgery, vol. i. *Larrey*, Mém. de Chir. Militaire, tom. ii. p. 379. *Pelletan*, Clinique Chir. t. ii. p. 240, &c. *Richerand*, Nosographie Chir. t. iv. sect. sur les Maladies des Artères, p. 23. &c. edit. 4. *Jones*, On the Process employed by Nature in suppressing the Hemorrhage from Divided and Punctured Arteries, 1805. *Hodgson*, On the Diseases of Arteries and Veins. *Benj. Travers*, Observations upon the Ligature of Arteries, and the Causes of Secondary Hemorrhage, &c. in Med. Chir. Trans. vol. iv. p. 435. et seq. Likewise Further Obs. on the Ligature of Arteries, by the same, in Med. Chir. Trans. vol. vi. p. 632. et seq. *W. Lawrence*, On a New Method of Tying the Arteries in Aneurism, Amputation, &c. in vol. vi. of the Med. Chir. Trans. p. 156, &c.; and Crampton, in vol. vii. of the same work. *Langenbeck*, Bibl. b. i. *Dr. J. Thomson*'s Lectures on Inflammation, p. 250, &c.; and Obs. made in the Military Hospitals in Belgium, p. 42—44. *Scarpa*, On Aneurism, and particularly his Memoir on the Ligature of Arteries: this is contained in the second edit. of the Transl. by *Wishart*. *Beclard*, Expériences sur les Blessures des Artères Mém. de la Soc. Méd. d'Emulation, t. viii. *Robt. Harrison*, Surgical Anatomy of the Arteries, 2 vols. Dublin, 1824-25. *T. Turner*, On the Arterial System, &c. and the Surgical Treatment of Hemorrhage, 8vo. Lond. 1825. *Velpeau*, Anatom. Chir. 2 tomes, 8vo. Paris, 1825. *John Green Crosse*, A Case of Amputation, with some Experiments and Observations on the securing of Arteries with minute Silk Ligatures, in Lond. Med. Repository, vol. vii. p. 353. *P. J. Manec*, Traité Theorique et Pratique de la Ligature des Artères, fol. Paris, 1832. *M. le Baron Dupuytren*, Leçons Orales de Clinique Chir. t. iv. art. 13, 8vo. Paris, 1834. *G. J. Guthrie*, On the Diseases and Injuries of Arteries, 8vo. Lond. 1830. *J. Lisfranc*, Des Diverses Méthodes pour l'Oblitération des Artères, 8vo. Paris, 1834. *L. J. Sanson*, Des Hémorrhagies Traumatiques, 8vo. Paris, 1836. *Robert Carswell*, Illustrations of the Elementary Forms of Disease; Fasciculus 6. 4to. Lond. 1834.

HEMORRHOIDS. (from *αἷμα*, blood, and *ῥέω*, to flow.) See Piles.

HERNIA. (from ἕρνος, a branch, from its protruding forward.) A protrusion of any viscus from its proper cavity is called a hernia; and the term, of course, comprises that very frequent case in which a tumour is formed by the protrusion of some of the viscera of the abdomen, out of that cavity into a kind of sac, composed of the portion of peritoneum, which is pushed before them. With respect to abdominal herniæ, however, some cases will not be embraced by this definition; either because the parts are not protruded at all, or have no hernial sac. Yet it is only in rare cases, that the sac is wanting; as, for example, when the hernia has been produced by the operation of great violence, or has been preceded by a wound of the abdominal parietes, or an attempt at a radical cure has been made with caustic. The sac is also sometimes rendered imperfect by laceration or ulceration. A hernial sac is sometimes burst by a blow. "When this happens (as Sir Astley Cooper has observed) its contents escape out of the sac, and become placed under the contiguous skin, so that the viscera require to be returned into the sac, before they can pass into the abdomen." He attended a case of inguinal hernia, in which these circumstances were exemplified. (*On Abdominal Hernia*, ed. 2., by *C. Aston Key*, part i.) Some viscera, which occasionally protrude, are not included in the peritoneum, as the bladder and cœcum; and, when they are considerably displaced, they draw after them the portion of peritoneum connected with them, which forms a sac into which other bowels may fall. There may be no sac, when a hernia arises from malformation of the muscles, attended with abdominal openings in them; for these are not always closed by peritoneum. (*Sir Astley Cooper*, *Op*. cit.)

"The brilliant progress, which surgery has made in modern times (says Scarpa) is, properly speaking, only the result of pathological anatomy; that is to say, of exact comparisons of the natural state of our organs with their different diseases, which may depend upon an alteration of texture, a derangement of functions, a solution of continuity, or a change of situation. It is from morbid anatomy that the most rational curative methods, with which modern surgery is enriched, are deduced as so many corollaries; methods to which we are also indebted for the perfection of operations.

"There are, indeed, a certain number of surgical operations, for the prompt and safe execution of which mere anatomical knowledge will suffice; but, in many others, the surgeon cannot promise himself success, even though he be well acquainted with anatomy, unless he has particularly studied the numerous changes of position, and alterations of texture, of which the parts upon which he is about to operate are susceptible. If he has not the requisite information upon all these points false appearances may deceive his judgment, and make him commit mistakes, sometimes of a very serious and irreparable kind.

"In order to have a convincing proof of this truth, it will be sufficient to take a view of the different species of herniæ, and their numerous complications. Assuredly, no anatomist would believe, that the intestine cœcum, naturally fixed in the right iliac fossa, and the urinary bladder, situated at the bottom of the pelvis, could undergo, without being torn, so considerable a displacement as to protrude through the abdominal ring, and descend even into the scrotum; that the same intestine, the cœcum, could pass from the right iliac region to the umbilicus, protrude at this opening, and form an umbilical hernia; that the right colon could have been found protruded from the abdomen at the left abdominal ring, and the left colon through the right one; that the liver, spleen, and ovary could sometimes form the contents of umbilical, inguinal, and femoral herniæ; that the cœcum could engage itself within the colon, and even protrude at the anus; that the stomach could be forced through the diaphragm, and form a hernia within the chest; that the omentum, or intestine, or both these parts together, could sometimes escape from the belly through the foramen ovale, or sacro-ischiatic notch of the pelvis." (See *Scarpa*, *Traité des Hérnies*, *Pref.*)

The parts of the body, where herniæ most frequently make their appearance, are the groin, the navel, the labia pudendi, and the upper and fore part of the thigh: they may occur at any point of the anterior part of the abdomen; and, in less common instances, at the foramen ovale, in the perineum; in the vagina; at the ischiatic notch, &c.

The parts which, by being thrust forth from the cavity, in which they ought naturally to remain, mostly produce herniæ, are either a portion of the omentum, or a part of the intestinal canal, or both together. But the stomach, the liver, spleen, uterus, ovaries, bladder, &c., have been known to form the contents of some hernial tumours. Indeed, as Sir Astley Cooper remarks, there is no part of the abdomen at which a hernia may not occur, excepting where it is bounded by bone; and, if the muscles be imperfectly formed, even the kidney may protrude in the loins. The small intestine is more frequently protruded than the large, and the ileum more frequently than the jejunum, in consequence of its greater proximity to the ring and crural arch. A part only of the diameter of the tube is sometimes included in a hernia: any larger quantity may descend, from a single fold to the whole moveable portion of the canal. (See *Lawrence on Ruptures*, p. 5. ed. 4.) The viscera more frequently met with than any others, in a hernia, are the omentum and the ileum; the next in frequency is the colon; then the cœcum; and, lastly, the jejunum. Sometimes the appendix cœci is the only part found in the hernial sac. (*Sir Astley Cooper on Abdominal Hernia*, ed. 2.) A hernia is referred to by Mr. Crosse, which consisted solely of the appendix vermiformis; this was enlarged to four times its natural size, and produced most of the usual symptoms of strangulation, so that the operation was required. (See *Trans. of Provincial Assoc.*, vol. v.)

From these two circumstances of situation and contents are derived all the different appellations by which herniæ are distinguished. If a portion of intestine alone form the contents of the tumour the case is called *enterocele*; if a piece of omentum only, *epiplocele*; and if both intestine and omentum contribute to the formation of the tumour, it is called an *entero-epiplocele*. When the contents of a hernia protrude at the abdominal ring, but only pass as low as the groin, or labium pudendi, the case receives the name of *bubonocele*, or *inguinal hernia*; but, if the parts descend into the scrotum, it is called an *oscheocele* or *scrotal hernia*. The *crural* or *femoral hernia* is the name given to that which takes place below Poupart's ligament. When the bowels protrude at the navel, the case is named an *exomphalos* or *umbilical hernia*; and *ventral* is the epithet given to the swelling, when it occurs at any other promiscuous part of the front of the abdomen. The *congenital rupture* is a particular case, in which the protruded viscera are not covered by a common hernial sac of peritoneum, but are lodged in the cavity of the tunica vaginalis, in contact with the testicle; and, as must be obvious, it is not named, like herniæ in general, from its situation or contents, but from the circumstance of its existing from the time of birth.

When the protruded bowels lie quietly in the sac, and admit of being readily put back into the abdomen, the case is termed a *reducible hernia*;

and when they suffer no constriction, yet cannot be put back, owing to adhesions, or their large size in relation to the aperture through which they have to pass, the hernia is termed *irreducible*. An *incarcerated or a strangulated hernia* signifies one, which not only cannot be easily reduced, or cannot be reduced without an operation, but suffers constriction; so that if a piece of intestine be protruded, the pressure, to which it is subjected, stops the passage of its contents towards the anus, excites inflammation of the bowel, and brings on a train of alarming, and often fatal, consequences.

The causes of herniæ are either *predisposing* or *exciting*. Amongst the former, writers mention a preternaturally large size of the openings, at which the bowels are liable to protrude; a weakness and relaxation of the margins of these apertures; extraordinary laxity of the peritoneum; an unusually long mesentery, or omentum, &c. With regard to the abdominal ring, the transverse tendinous fibres, which naturally cross and strengthen its upper and outer part, are much weaker in some subjects than others. No idea seems more prevalent in books, than, that taking a good deal of oil with our food is conducive to the formation of hernial diseases. Some of the alleged predisposing causes may justly excite scepticism; but several circumstances prove, that a natural deficiency of resistance, in any part of the parietes of the abdomen, promotes the occurrence of hernia. Hence, persons who have had the peritoneum wounded, are very liable to the present disease. (*Richerand, Nosogr. Chir.* t. iii. p. 317.; *Schmucker, Vermischte Chir. Schriften*, b. i. p. 197.) Men are much more liable than women to inguinal hernia, evidently from the larger size of the inguinal canal; while, in women, as there is a larger space for the protrusion of the viscera, below Poupart's ligament, they are more exposed than men to femoral herniæ. The distention of the abdomen in pregnancy, also gives a disposition to crural and umbilical hernia.

With regard to the *exciting* causes, our knowledge is involved in less doubt. The grand cause of this kind is the powerful action of the abdominal muscles and diaphragm on the viscera. In feats of agility, such as jumping, &c. the pressure which the contents of the abdomen must often encounter, sufficiently accounts for their protruding at any part where the abdominal parietes do not make adequate resistance. The same consideration explains why herniæ very often take place in lifting and carrying heavy weights, running, vomiting, straining at stool, parturition, &c. and in people who inhabit mountainous countries. In individuals who have long laboured under bad strictures, the habitual efforts of the abdominal muscles to make the urine pass, often bring on the formation of hernia. In Sir Astley Cooper's splendid work is the representation of a case of this kind, in which several herniæ were produced.

The diminution of the capacity of the abdomen, by the action of the abdominal muscles and diaphragm, in many occasional exertions, must take place in every body, by reason of the common habits and necessities of life. But, as only a certain number of persons meet with the disease, it is fair to infer, that either the exciting causes must operate with greater force in them, than in the generality of people, or else that their abdominal parietes have not been capable of the ordinary degree of resistance. Many patients, who meet with herniæ in making violent efforts and exertions, may be in the former circumstance; while others, whose viscera protrude from such trivial things as coughing, sneezing, crying, &c., must be considered as being under the influence of some predisposing cause. "Herniæ, which originate in predisposition, generally come on gradually, and almost imperceptibly; while those which are produced by bodily exertions, are formed suddenly, and by the immediate action of the exciting cause. The occurrence of the complaint is often indicated, in the first instance, by a fulness, combined with a sense of weakness, about the abdominal ring. The swelling is increased by any action of the respiratory muscles, and disappears on pressure, and in the recumbent position of the body. It gradually finds its way through the tendon of the external oblique muscle into the groin, and afterwards into the scrotum. When a hernia takes place suddenly, it is generally attended with a sensation of something giving way at the part, and with pain." (*Lawrence on Ruptures*, p. 42. ed. 4.)

Upon the subject of the immediate cause of herniæ, it is observed by Scarpa, that several distinguished modern surgeons, as, for instance, Warton (*Adenograph.* cap. 11.), Benevoli (*Dissertazioni Chir.* 1.), Rossius (*Acta Nat. Cur.* t. ii. obs. 178.), Brendel (*De Herniarum natalibus*), and Morgagni (*De Sed. et Caus. Morb.* epist. 43. art. 13.), consider a relaxation and elongation of the mesentery as the principal cause of herniæ in general, and of the bubonocele in particular. Hence, say they, the whole mass of intestines, or only a portion of an intestine, descends against the inner orifice of the inguinal ring, presses against this opening, and gradually makes its way out of the abdomen. In examining this pathological point without prejudice, it is incontestable, says Scarpa, that an intestine cannot be moved beyond its natural limits, unless that part of the mesentery, which retains and fixes the bowel in its proper place, be at the same time elongated. But, it does not follow from this, that a relaxation of the mesentery must precede the displacement of the intestine. It appears to Scarpa much more probable, that these two events are simultaneous, and depend upon one and the same cause.

"In the healthy state, the abdomen, considered altogether, is submitted to two opposite forces, which reciprocally balance each other. One is the pressure of the viscera against the abdominal parietes, the other is the reaction of these same parietes upon the viscera which they contain. If these two forces were in perfect equilibrium in all individuals, and under all the circumstances of life, we should not be in the least subject to herniæ. If, when the equilibrium has been broken, every point of the parietes of the belly were to yield equally to the impulse of the viscera, an increase of the volume of the whole abdomen would be the consequence, but a true hernia would never happen. The cavity of the abdomen is always completely full. The containing and contained parts react upon, and reciprocally compress, one another. It is by the effect of this moderate, but equal and unremitting pressure, that all the viscera mutually support each other. Without it, the ligaments of the liver, those of the spleen, and the various membranous bands of the intestines in general, would only be feeble means for fixing such parts in their respective situations. But, there are certain points of the abdominal parietes which naturally present much less resistance than others, and which react with much less power against the pressure made from within outwards by the abdominal viscera. Such is, particularly, the part which extends from the pubes to the anterior superior spinous process of the ilium. This relative weakness of some points of the abdominal parietes is very marked in certain individuals, in consequence of a defect of organisation. It may also be increased by internal or external causes, which are as various as they are numerous. When, in one of these cases, the pressure made by the viscera is unusually increased, as happens in a violent effort, a defect in the equilibrium between the two forces above mentioned is occasioned; that is to say, the reaction of the abdominal parietes is no longer proportioned, at least at certain points, to the force of the impulse of the viscera. The conjoined powers of the abdominal muscles, diaphragm, and levator ani, are then directed and concentrated against the most feeble point of the abdomen, towards which they propel the nearest viscus, or that which, from its moveableness, is the most liable to displacement. If such viscus should happen to be the noose of an intestine, it is evident that the power, which tends to make it protrude from the belly, must at the same time act upon the corresponding portion of the mesentery; and the intestine, in passing through the parietes of the abdomen, drags the mesentery after it, and makes this membrane yield and become elongated. When the displaced viscera meet with little resistance on the part of the parietes of the abdomen, the hernia is quickly formed, and the elongation of the mesentery occurs with equal celerity. We have an example of this in inguinal congenital hernia: in this case the intestine is, in some measure, precipitated into a sac previously prepared for its reception. On the contrary, in the ordinary inguinal hernia, a totally different disposition of the parts renders the progress of the disease much slower. In most instances, the hernia is not formed immediately the equilibrium between the impulse of the viscera and the reaction of the abdominal parietes is broken; but in the groin a slight elevation is first observed in the direction from the anterior superior spinous process of the ilium towards the inguinal ring. Some time afterwards, when the intestine has made its appearance on the outside of the ring, the enlargement of the hernia, and the elongation of the mesentery, make much more rapid, though always simultaneous progress.

"Numerous practical observations (says Scarpa) concur in proving, that we must not search for the immediate cause of herniæ in the relaxation of the mesentery, but rather in a want of equilibrium between the pressure of the viscera and the resistance of one or several points of the abdominal parietes. Indeed, herniæ are seen occurring from the slightest causes in infants, in whom the neck of the tunica vaginalis is not speedily obliterated, and in individuals who, from being fat, have, all on a sudden, become extremely thin. Such women as have had children, are more subject to the disease than others. Persons also of both sexes, who carry considerable burdens or who play upon wind instruments, or who have suffered a forcible contusion of the abdomen, are particularly exposed to the disorder, even though there be not the least reason for suspecting in them a relaxation of the mesentery. Vaginal herniæ which arise after difficult labours, afford another proof of the same truth: their cause is owing to a laxity and weakness of the parietes of the vagina, which, not being capable of making any further resistance to the pressure of the viscera, situated in the cavity of the pelvis, at length suffer these parts to protrude.

"With respect to the second proposition, that during the formation of a hernia, the combined force of all the abdominal muscles is, as it were, directed and concentrated against the most feeble point of the parietes, we see a proof of it in a fact that occurs to our observation every day. In order to convince ourselves of this, we need only notice what happens in individuals afflicted with herniæ: if they cough, or sneeze, or make the slightest effort, they instantly find the size of the swelling increased, and hasten to support the part with their hand. During the slightest efforts, which render the herniæ larger, it is also indisputable, that the mesentery is elongated in the same proportion as the intestine protrudes. All the viscera have such a tendency to be displaced, and carried towards the weakest point of the parietes of the abdomen, that even those which are naturally the most distant from it, and are the most firmly fixed by the folds of the mesentery, may, in their turn, descend into the herniæ. Anatomical knowledge alone would never have led us to entertain a suspicion of the possibility of these occurrences. Sandifort and Paletta have found, in an umbilical hernia, the cœcum, with a portion of the ileum and colon. (*Obs. Pathol.* cap. iv., and *Nova Gubernaculi Testis Descriptio.*) Mauchart, Camper, and Bose, have met with the cœcum in an inguinal hernia of the left side, (*De Hern. Incarc. in Halleri Disput. Chirurg.* t. iii.; *Demonstrat. Anat. Patholog.* lib. ii. p. 18.; *et Animadvers. de Hern. Inguin.* p. 5.) Lassus has seen the left colon protrude at the right inguinal ring. (*Méd. Operatoire*, t. i. p. 173.) If it be proved by all these facts, that such viscera, as are the most closely united to the great sac of the peritoneum and neighbouring parts, are nevertheless liable to form herniæ; and if such displacements cannot happen without a considerable elongation of the membranous bands fixing these bowels in their natural situation, how can we refuse to admit, that a noose of intestine, pushed by degrees through the inguinal ring, drags along with it the corresponding portion of the mesentery? In order to explain this event, there is no necessity for supposing a partial relaxation of the mesentery." (*Traité Pratique des Hérnies, par A. Scarpa, trad.* p. 37—43.)

The same causes which first produced the complaint, or others of an analogous nature, are constantly tending to promote its increase. The tumour becomes larger, in proportion as the pressure against the hernial sac is stronger and more frequent. Hence, the great size, which it often attains in persons constantly pursuing laborious occupations. Its increase will also be in proportion to the less considerable resistance of the parts in which it is situated. Hence, the magnitude of scrotal ruptures, and the generally small size of a femoral hernia. The size of a hernia is likewise in part dependent upon the largeness and weakness of the opening, through which the protrusion happens. Hence, inguinal ruptures are usually much larger than those called femoral or crural. The looseness of the cellular connection of the peritoneum, is another cause of the disposition of a hernia to attain a considerable magnitude; while the shortness and closeness of the same uniting medium, operate, in particular cases, as a check to the enlargement of the tumour, as is exemplified in herniæ of the linea alba, which are generally small. When the sac, after it has passed the parietes of the abdomen, is situated among cellular, or adipous substance, it expands equally in all directions, and forms a nearly spherical tumour, being, however, generally rather flattened, as in umbilical and crural herniæ. If it protrude through a canal, it is nearly cylindrical, as in incipient inguinal herniæ; and even in those which have passed the ring, and are still confined by the sheath of the spermatic cord. The fundus of the sac enlarges as it descends into the scrotum, and thus, in almost all scrotal cases, the swelling becomes pyriform. Irregularities of shape often take place from the extension of the membrane in directions presenting the least resistance. At the first moment of the occurrence of a hernia of sudden formation, the protruded peritoneum is unconnected to the parts amongst which it lies; but adhesions take place so quickly, that the sac is found universally connected to the contiguous parts, even in a rupture of two or three days' standing. These adhesions prevent the return of the sac into the abdomen, when the contents of the swelling are replaced. The peritoneum, which immediately surrounds the protruded viscera, generally retains the same thin and delicate structure which characterises that membrane in its natural situation. It is covered by other investments, varying in thickness and structure, according to the part in which the swelling is formed, and the size and duration of the tumour, &c. (See *Lawrence on Ruptures*, p. 18, &c. ed. 4.)

Many interesting circumstances, in relation to hernial sacs, have been satisfactorily explained by Sir Astley Cooper and M. Cloquet; and some of them are noticed in Mr. Lawrence's work. "If the causes which have produced the hernia continue to operate, and further descent of the peritoneum be prevented by its strong adhesion to the tendinous opening, the sac becomes thin by distention. It may give way partially by a kind of laceration, and thus become irregular in figure, presenting an appearance of small cysts, or secondary cavities. On the contrary, when the neck does not adhere so strongly, and the mouth of the sac forms a thickened ring, the renewed action of pressure may make the ring descend, and a fresh one will form at the new mouth of the sac. This processs may be again repeated; and thus the sac presents one or more constrictions, by which the protruded parts may be compressed, and even strangulated. Inguinal and scrotal ruptures are almost the only cases in which this occurrence can take place. When a hernia passes through a canal, a thickened ring may be formed at both orifices of the canal. If a hernial sac has been formed, and its mouth become thickened, a new protrusion may take place by the side of it: this may occur again; and thus we may have sacs composed of two lateral cavities, or consisting of two or more secondary openings into one principal protrusion; or the original serous cavity may be contracted, and form a small appendix to the subsequent protrusion." (See *Lawrence on Ruptures*, p. 26.; and *J. Cloquet, Récherches sur les Causes, &c. des Hernies.*)

According to Sir Astley Cooper, however, the peritoneum, in forming a common hernial sac, "is not dragged from its natural situation, but becomes elongated by gradual distention; and it is usually not only lengthened, but slightly thickened; for a long-continued pressure of moderate force will produce an elongation and thickening of fibre, though a greater degree will bring about an entire absorption of parts." So far, however, as this distinguished surgeon has been able to ascertain by dissection, the seemingly great thickness of the hernial sac, and its apparent divisibility into several layers in old herniæ, are owing to the state of the coverings of the sac, the latter being generally but little thicker than the peritoneum.

Several hernial sacs are sometimes found in the same patient; and Sir Astley Cooper has recorded an instance in which this occasioned a difficulty in determining which protrusion was to be the subject of operation.

Herniæ are more frequent on the right, than on the left side of the body. This fact, as Mr. Lawrence has remarked, does not depend on any disparity in size between the apertures of the two sides, but must be referred to the employment of the right side in those offices of life which require the most powerful exertion. (*On Ruptures*, p. 33. ed. 4.) This subject has been particularly considered by Cloquet. (See *Recherches sur les Causes et l'Anatomie des Hernies Abdominales*, p. 10. &c. 4to. Paris, 1819.)

The general symptoms of a hernia, which is reducible, and free from strangulation, are, an indolent tumour at some point of the abdomen, most frequently descending out of the abdominal ring, or from just below Poupart's ligament, or else out of the navel; but, occasionally from various other situations, as will be presently explained. The swelling often originates suddenly, except in the circumstances above related, and it is subject to a change of size, being smaller when the patient lies down on his back, and larger when he stands up or holds his breath. It frequently diminishes when pressed, and grows large again when the pressure is removed. Its size and tension often increase after a meal, or when the patient is flatulent. In consequence of the unnatural situation of the bowels, many patients with hernia are occasionally troubled with colic, constipation, and vomiting. Sometimes, however, the functions of the viscera seem to suffer little or no interruption.

Sometimes the contained parts may be known by the symptoms. But, as Mr. Lawrence justly remarks, this discrimination is often difficult, and even impossible, when the hernia is old, large, and very tense: for, in cases of this description, the viscera experience considerable changes in their figure and state, while the thickened hernial sac prevents an accurate examination by the hand. (*On Ruptures*, p. 46. ed. 4.)

If the case be an *enterocele*, and the portion of intestine be small, the tumour is small in proportion; but, though small, if the bowel be distended with wind, inflamed, or have any degree of stricture made on it, it will be tense, resist the impression of the finger, and give pain upon being handled. On the contrary, if there be no stricture, and the intestine suffer no degree of inflammation, let the prolapsed piece be of what length it may, and the tumour of whatever size, the tension will be little, and no pain will attend the handling of it; upon the patient's coughing, it will feel as if it were blown into; and, in general, it will be found very easily returnable. (*Pott.*) A guggling noise is often made when the bowel is ascending. An enterocele is also generally characterised by the uniformity of its surface, and its elasticity.

If the hernia be an *epiplocele*, or one of the omental kind, the tumour has a more flabby, and a more unequal feel; it is in general perfectly indolent, is more compressible, and (if in the scrotum) is more oblong, and less round, than the swelling occasioned in the same situation by an intestinal hernia; and, if the quantity be large, and the patient adult, it is in some measure distinguishable by its greater weight. In very young subjects, the contents of a hernia are generally intestine, and but seldom omentum. (*Sir A. Cooper, Lectures*, vol. iii. p. 8.)

If the case be an *entero-epiplocele*, that is, one consisting of both intestine and omentum, the characteristic marks will be less clear than in either of the simple cases; but as the smooth slippery surface of the intestine generally makes its reduction easier than that of the omentum, we may infer, with Mr. Lawrence, "that if a portion of the contents slip up quickly and with noise, leaving behind something which is less easily reduced, the case is probably an entero-epiplocele." (*Op.* cit. ed. 4. p. 47.)

On the subject of prognosis, the age and constitution of the subject, the date of the disease, its being free, or not free from stricture, or inflammation, the symptoms which attend it, and the probability or improbability of its being returnable, necessarily produce much variety. If the subject be an infant, the case is not often attended with much difficulty or hazard, the reduction being easy as well as the descent; and though from neglect, or inattention, the bowel may fall down again, yet it is easily replaced, and mischief seldom produced: Mr. Pott says seldom, because he has seen an infant, one year old, die of a strangulated hernia, which had not been down two days, with all the symptoms of mortified intestine. For other examples of strangulated hernia in very young infants, refer to *Gooch's Chir. Works*, vol. ii. p. 33.; *Lawrence on Ruptures*, p. 77. edit. 4.; *Edinb. Med. and Surgical Journal*, vol. iii. p. 470, &c. "If the patient be adult, and in the vigour of life, the consequences of neglect, or of maltreatment, are more to be feared than at any other time, for reasons too obvious to need relating. The great and principal mischief to be apprehended, in an intestinal hernia, is an inflammation of the gut, and an obstruction to the passage of the aliment and feces through it; which inflammation and obstruction are generally produced by a stricture made on the intestine. In very old people, the symptoms do not usually make such rapid progress, both on account of the laxity of their frame, and their more languid circulation; and also because their ruptures are most frequently of ancient date, and the passage a good deal dilated: but then, on the other hand, it should also be remembered, that they are by no means exempt from inflammatory symptoms; and that if such should come on, the infirmity of old age is no favourable circumstance in the treatment, which may become necessary." (*Pott.*)

If the disease be recent, and the patient young, immediate reduction and constant care to prevent another protrusion, are the only means whereby it is possible to obtain a perfect cure.

If the case be an epiplocele, that has formed gradually, it seldom occasions any bad symptoms, though its weight will sometimes render it very troublesome. But if it be produced suddenly, by effort or violence, that is, if a considerable piece of the omentum slip down at once, it will sometimes prove painful and cause very disagreeable complaints; the connection between the omentum, stomach, duodenum, &c. being such as to render the sudden descent of a large piece of the first sometimes productive of nausea, vomiting, and colic. When the piece of omentum is engaged in such a degree of stricture as to prevent the circulation of blood through it, it will sometimes, by becoming gangrenous, be the occasion of very bad symptoms, and even of death, as Mr. Pott, and all surgeons of experience have seen. But even though the portion of the omentum should remain uninjured in the scrotum, "yet, as Pott correctly relates, it renders the patient constantly liable to hazard from another quarter; it makes it every moment possible for a piece of intestine to slip into the same sac, and thereby add to the case all the trouble and all the danger arising from an intestinal rupture. It is by no means an uncommon thing for a piece of gut to be added to a rupture, which had for many years been merely omental, and for that piece to be strangulated, and require immediate help.

"An old omental hernia is often rendered not reducible, more by an alteration made in the state of the prolapsed piece of caul, than by its quantity. It is very common for that part of the omentum, which passes through the neck of the sac, to be compressed into a hard, smooth, body, and lose all appearance of caul, while what is below in the scrotum is loose and expanded, and enjoys its natural texture; in this case, reduction is often impossible, from the mere figure of the part; and I have so often seen this, both in the living and the dead, that I am satisfied, that for one omental rupture, rendered irreducible by adhesions, many more become so from the cause above mentioned." (*Pott.*)

Upon the whole, this author infers, that an intestinal rupture is subject to worse symptoms, and a greater degree of hazard, than an omental one, though the latter is, by no means, so void of either as it was formerly supposed to be; that bad symptoms are more likely to attend a recent rupture, than one of ancient date; that the descent of a very small piece of intestine is more hazardous than that of a larger; and that the hernia, which consists of gut only, is in general attended with worse circumstances, than that which is made up of both gut and caul. (See also *Lawrence on Ruptures*, p. 75, 76. ed. 4.)

Mr. Hey coincides with Pott, in thinking the prognosis more unfavourable when the tumour is small. "I think it is not a bad general rule, that the smaller the hernia, the less hope there is of reducing it by the taxis. Long-continued efforts to reduce a prolapsed intestine, are most likely to succeed in old and large hernias, when no adhesions have taken place." (*Pract. Observ. in Surgery*, p. 203.)

It is correctly remarked by Mr. Lawrence, that "the danger is greatest, when a rupture is incarcerated (strangulated) at the moment of its formation. Herniæ, which arise spontaneously, and merely from predisposing weakness, seldom become strangulated; the stricture, in such cases, is never close, nor are the symptoms violent, because the parts concerned are weak and relaxed. The opening, through which the parts protrude, is narrower in some situations than in others; the progress of the case will therefore be more rapid, and the danger of the patient more urgent. The aperture is generally very small in femoral hernia; this kind of rupture in men, and the bubonocele in women, have a particularly narrow entrance. On the same grounds, femoral, inguinal, and umbilical, ruptures, are more dangerous, than the ventral, perineal, or vaginal kinds." (*On Ruptures*, p. 75. ed. 4.)

Treatment of a Hernia capable of easy and immediate Reduction, and not attended with any troublesome or bad Symptoms.

Here the first indication is to reduce the protruded viscera, without delay, and to prevent them from descending again, by the application of a suitable truss. As soon as the parts are returned, the truss should be immediately put on, and worn without remission; care being taken, especially if the patient be an infant, to keep the parts upon which it presses regularly washed, to prevent galling. It ought to fit properly; for, one "which does not press enough, is worse than none at all, as it occasions loss of time, and deceives the patient, or his friends; and one which presses too much, or on an improper part, gives pain and trouble, by producing an inflammation and swelling of the spermatic cord, and sometimes of the testicle.

"In adults, whose ruptures are of long standing, and accustomed to frequent descent, the hernial sac is generally firm and thick, and the aperture in the tendon of the abdominal muscle large; the freedom and ease with which the parts return into the belly when the patient is in a supine posture, and the little pain which attends a rupture of this kind, often render the persons who labour under it careless: but all such should be informed, that they are in constant danger of such alteration in their complaint, as may put them into great hazard, and perhaps destroy them. The passage from the belly being open, the quantity of intestine in the hernial sac is always liable to be increased, and, when down, to be bound by a stricture. An inflammation of that portion of the gut which is down, or such obstruction in it as may distend and enlarge it, may at all times produce such complaints as may put the life of the patient in imminent danger; and therefore, notwithstanding this kind of hernia may have been borne for a great length of time, without having proved either troublesome or hazardous, yet as it is always possible to become so, and that very suddenly, it can never be prudent or safe to neglect it.

"Even though the rupture should be of the omental kind (which, considered abstractedly, is not subject to that degree or kind of danger to which the intestinal is liable), yet it may be secondarily, or by accident, the cause of all the same mischief; for while it keeps the mouth of the hernial sac open, it renders the descent of a piece of intestine always possible, and consequently always likely to produce the mischief which may proceed from thence."

Mr. Pott comments upon the importance of having the parts completely reduced before the truss is applied, and upon the danger that may be incurred by laying such instrument aside after it has been worn some time; since the partial closure of the passage, whereby the descent of the bowel is rendered less easy, will also make the reduction more difficult, if a piece should happen to slip down: and hence he insists, that a truss "should be long and unremittingly worn by all those, whose time of life makes the expectations of a perfect cure reasonable, many of the ruptures of adults being owing to the negligent manner, in which children at school are suffered to wear their trusses." (See Truss.)

Besides the danger of strangulation, and the loss of all chances of a radical cure, when a reducible hernia is neglected, and allowed to remain down, there are other motives for keeping up the tumour with a truss, and preventing its increase of size. The vast size, to which neglected herniæ sometimes increase, not only prohibits all active exertion, but, by involving, in the male, the integuments of the penis, incapacitates the patient from the act of copulation, and gives rise to excoriation from the discharge of the urine over the swelling. Probably, too, the testis may be affected by the pressure of a very large scrotal hernia. (*Morgagni, de Caus. et Sed.* ep. xxxiii. art. 12.; *Schmucker, Vermischte Chir. Schriften*, b. iii. p. 195.) Disorders of the intestinal functions invariably attend these large ruptures, and increase in frequency and violence in proportion to the size of the swelling, and age of the patient. All the moveable viscera of the abdomen gradually find their way into the hernial sac, if a rupture be entirely neglected. (*Lawrence on Ruptures*, p. 80. edit. 4.)

Treatment of irreducible Herniæ, free from Inflammation, and unattended with troublesome or dangerous Symptoms.

Mr. Pott, and all the best writers on ruptures, ascribe the incapacity of reduction, in most cases, either to the largeness of the quantity of the contents, an alteration made in their form and texture, or to adhesions, which they have contracted with each other or their containing bag. The reduction is also sometimes prevented by transverse membranous bands within the sac. Mr. Pott was also aware, that ruptures are sometimes rendered difficult to be reduced, by the cœcum being contained in the hernial sac. Of this fact, he was as much convinced, as the nature of such kind of things would permit; that is, by observations made both on the living and the dead. This statement, made many years back, deserves particular notice, because its truth is confirmed by the modern observations of Scarpa.

Mr. Pott has adverted to the kind of impediment to reduction produced by the thickening of the neck of the sac, when the hernia is long neglected, and suffered to remain in the scrotum, without any bandage to support its weight.

The same author reckons an alteration produced by time, and constant, though gentle, pressure, in the form and consistence, or texture of the omentum, as no infrequent cause why neglected omental ruptures become irreducible.

When a portion of omentum "has been suffered to remain for a great length of time in the scrotum, without having ever been returned into the belly, it often happens, that although that part of it which is in the lower part of the hernial sac preserves its natural soft, adipose, expansile state, yet all that part, which passes through what is called the neck of the sac, is, by constant pressure, formed into a hard, firm, incompressible, carnous kind of body, incapable of being expanded, and taking the form of the passage in which it is confined, exactly filling that passage, and rendering it impossible to push up the loose part which fills the scrotum.

"The same reason for incapacity of reduction is also sometimes met with in ruptures of the intestinal kind, from an alteration produced on that part of the mesentery which has been suffered to lie quiet for a great length of time in the neck of an old hernial sac.

The other impediment to the return of old ruptures, is the connection and adhesion of the parts, either with each other, or with the sac containing them. This is common to both the intestinal and omental hernia, and is produced by slight inflammations of the parts, which have been permitted to lie long in contact with each other. These adhesions are more or less firm, and more or less extensive, in different cases; but even the slightest will almost always be found an invincible objection to the reduction of the adherent parts, by the hand only. They are most frequently situated at the lower part of the sac, but sometimes at its mouth. (Sir *A. Cooper*, *Op.* cit. p. 27.)

Irreducible herniæ, from any of the foregoing circumstances, are capable of no relief from surgery, but the application of a suspensory bandage for the purposes of lessening the inconvenience of the weight of the tumour, and of checking, by means of pressure, the increase of the swelling. But (according to Sir Astley Cooper), if the hernia be omental only, its increase, and the subsequent descent of the intestine, may safely be prevented by a spring truss. Yet, he acknowledges, that there is so much difficulty in determining the precise nature of the hernia, and whether some small convolution of intestine may not have descended, that the truss should not be applied, without a most careful examination; and he recommends the spring to be weak. If the instrument should produce pain, or interrupt the functions of the bowels, it ought to be immediately discontinued.

Persons having irreducible herniæ, "should be particularly careful not to make any attempts beyond their strength, nor aim at feats of agility; they should take care to suspend the loaded scrotum, and to keep it out of the way of all harm from pressure, bruise, &c. When the tumour is very large, a soft quilted bolster should be worn at the bottom of the suspensory to prevent excoriation, and the scrotum should be frequently washed for the same reason; a loss of skin in this part, and in such circumstances, being sometimes of the utmost importance. They ought also to be particularly attentive to the office of the intestinal canal, to see that they do not, by any irregularity of diet, disorder it, and keep themselves from being costive." Mr. Pott observes, however, that the quiet, inoffensive state of this kind of hernia is by no means to be depended upon: many things may happen to it, by which it may be so altered, as to become hazardous, and even fatal: an inflammation of that part of the gut which is down, any obstruction to the passage of the aliment or feces through it, a stricture made either on what has been long down, or on a new portion which may at any time be added to it, are always capable of so altering the state of the case, as to put the life of the patient into danger.

"Indeed, the hazard, arising from a stricture, made on a piece of intestine contained in the sac of an old irreducible hernia, is in one respect greater than that attending one that has been found at times reducible; since from the nature of the case it will hardly admit of any attempt toward relief, but the operation, which, in these circumstances, must necessarily be accompanied with additional difficulty."

Patients with irreducible hernia, are exposed indeed, to various dangers and inconveniences; as for instance, to laceration of the intestine by accidental blows; to ulceration of it when any pointed or hard body has been swallowed; to dropsy of the hernial sac; and to a fistulous abscess of the scrotum, which can hardly ever be healed, except by confining the patient in bed. (See *Sir A. Cooper on Abdominal Hernia*; chap. vi. ed. 2. *Travers, on Wounds of the Intestines*, p. 37.) Scarpa has recorded an instance, where a violent exertion caused the return of a hernia, which had long been regarded as cured. The viscera lay in the tunica vaginalis, which was torn to the extent of an inch.

Fabricius Hildanus gives an account of a man who was radically cured of a rupture, of twenty years' date, by six months' confinement to bed. (*Cent.* v. obs. 54.) Le Dran and Arnaud relate instances of monstrous bubonoceles, which disappeared entirely, after the patients had been long confined to bed, and rendered much emaciated by tedious illnesses. Some of the moderns have imitated this operation of nature, and by frequent bleedings and repeated purges, have sometimes so far reduced the size of the hernia, that it has been returned into the abdomen. Mr. Hey has several times succeeded in this way. (P. 219.) But the practice cannot prove successful, when the viscera adhere to the sac, or to the peritoneum, just within the abdomen. The greatest objection to this method of cure, is the want of an absolute criterion for distinguishing, when the parts do, or do not adhere to the hernial sac; and, in advanced years, though one were sure that the viscera were free from the sac, the possibility of hurting the constitution, by the necessary evacuations, is also another objection. (*Sharp's Critical Inquiry*, p. 15.)

Were the plan to be thought worthy of trial, keeping up a constant pressure on the tumour, by means of a suspensory bandage, made to lace in front, would be proper for promoting the absorption of the thickened parts in the hernial sac. Sir A. Cooper has reduced such herniæ after applying ice to them; the good effects of which he imputes to its producing a contraction of the scrotum, and by this means a strong and permanent compression of the tumour. Mr. Earle once mentioned to me the suggestion of keeping up a general pressure on the swelling, by means of a bladder containing quicksilver, the quantity of which can be regulated according to circumstances.

Whenever any attempt of this kind succeeds a truss should be immediately put on, and worn without remission.

However, there are instances on record, where the capacity of the abdomen had become so adapted to the diminished quantity of the viscera, that when the contents of the hernia had been reduced, serious complaints arose from their introduction into the belly. Schmucker met with several such cases, in which he was obliged to take off the truss again. Petit has known the reduction of a hernia of this kind prove fatal, the parts not descending again, when the truss was removed, the nausea and vomiting continuing, and peritonitis taking place. (*Chirurgische Wahrnehmungen*, vol. ii. p. 243. *Maladies Chir.* t. ii. p. 392.)

Mr. Pott remarks, "that an omental rupture, which has been so long in the scrotum as to have become irreducible, is very seldom attended with any bad symptoms, considered abstractedly; but, it is constantly capable of being the occasion of an intestinal hernia, and all its consequences: neither is that all; for the omentum, either so altered in form and texture, or so connected as to be incapable of reduction, may by accident inflame, and either become gangrenous, or supurate, and the occasion of a great deal of trouble." In a few instances, epiplocles produce very bad symptoms indeed; cases of which are to be found in Garengeot, Dionis, &c.

Symptoms and Treatment of a Strangulated, or an Incarcerated Hernia. — Means to be tried before an Operation.

If the prolapsed parts cannot be immediately replaced, and the patient suffers pain, or is prevented thereby from going to stool, the case is called *an incarcerated hernia, a strangulated hernia*, or *a hernia with stricture.*

A patient, thus circumstanced, is in some danger, and demands immediate assistance. A stricture made on the prolapsed part of the gut, by the aperture, or canal, through which it passes, is the immediate cause of all the bad symptoms, and of course, the removal of such stricture is the only thing which can bring relief. This object can only be accomplished by returning the bowel back into the abdomen, or dividing the parts, which form the stricture. The former plan is always the most desirable when practicable.

I next proceed to notice the various measures to be adopted for the relief of a strangulated hernia, so as to obtain the best chance of obviating the necessity of an operation. After treating of the merits of each plan, a few remarks will be offered on the order in which these means should be put in practice.

Taxis. — This is the term applied to the operation of reducing a hernia with the hand. It is to be promoted by the position of the body, which Winslow thought should be placed on an inclined plane, with the thighs bent towards the trunk. Sir A. Cooper advises the same practice, observing, that this posture, by relaxing the fascia of the thigh, relaxes also the aperture, through which the hernia passes. Every degree of tension, and relaxation of the femoral fascia, must undoubtedly be attended with a corresponding change in the abdominal ring. But, flexion of the thigh, besides relaxing this fascia, also relaxes the abdominal, internal iliac, and psoas muscles. In common inguinal hernia, the pressure made on the tumour by the hands of the surgeon should always be directed upwards and outwards, along the course of the spermatic chord; and Sir A. Cooper advises it to be continued from a quarter to half an hour.

As the femoral hernia passes downwards, and then forwards, the pressure must be directed first backwards, and then upwards. In umbilical and ventral herniæ, it is to be made straight backwards. No violence should ever be used; for, besides being unavailing, it greatly aggravates the inflamed state of the contents of the hernial sac, and has been known even to burst the intestine. (See *Sir A. Cooper on Inguinal Hernia, &c.*, p. 23.)

Besides bending the thigh, care should also be taken to rotate it inwards, which will have great effect in relaxing the femoral fascia, and tendon of the external oblique muscle. Suspension of the patient over the shoulders of an assistant has been thought to facilitate reduction: — "I have tried it often (says Mr. Hey), but have not found it to be of such superior efficacy, as some authors have represented." (P. 144.)

The manœuvre of gently pulling the intestine downwards, or a little way further out of the ring, previously to the attempt to reduce the hernia, has been suggested. (See *Balfour's New Mode of the Taxis*, in *Med. and Phys. Journ.* Nov. 1824.) The plan, I believe, is not entirely new: Mr. Lawrence says, that it will sometimes succeed, when the difficulty of reduction is owing to an accumulation of fecal matter.

The application of cupping glasses, or dry cupping, to facilitate the taxis, has been recommended: how this application acts has not been ascertained. Does it operate by drawing the intestine a little further out in the first instance? It is said to be most serviceable when the hernia is small, and the cupping glass covers the whole tumour; but the plan has been tried with good effect even in large herniæ. (See *Erfahrungen über den Gebrauch des Saugpumpe bei eingeklemmten Brüchen von Dr. L. Köhler* (Warsaw) in *Hecker's Neue Wissenschaftliche Annalen der gesammten Heilkunde*, vol. i. p. 382. 1835. Also *J. G. Crosse* in *Provincial Med. Trans.* vol. v., and *Encyclographie des Sciences Méd. Mars*, 1836.) I know nothing about the merits of this plan from my own experience.

The return of a piece of intestine is generally preceded by a peculiar noise, caused by the passage of air through the stricture. It recedes at first gradually, and then slips up suddenly. The omentum goes up slowly to the very last portion, which must be actually pushed through the opening. If the taxis should not succeed at first, it will often do so after the warm bath, bleeding, or cold applications. Small herniæ, being attended with the closest stricture, are the most difficult to reduce; and, for the same reason, crural ruptures do not so often yield to the taxis, as inguinal herniæ in the male subject. The taxis becomes less likely to succeed, the longer the inflamed viscera have been down, because adhesions are liable to form. Mr. Lawrence observes (p. 63.), " When the rupture becomes painful, we are no longer justified in persevering in attempts at reduction by the hand. A sufficient pressure cannot now be endured; and the force, which is employed, only tends to increase the inflammation, and accelerate the approach of gangrene. *At this period the operation is required, and should be performed without delay.*" Desault even proscribed the taxis altogether in the inflammatory strangulation, until the previous use of other means had produced a change in the state of the swelling.

That the taxis is frequently abused, and the cause of serious mischief, is a truth which cannot be doubted. "Strangulated herniæ (says Scarpa) very frequently mortify from the negligence of the patients, and their repugnance to submit to an operation; and, perhaps, still more frequently from the effect of the taxis, unskilfully exercised by uninformed surgeons, who are determined, at any price whatsoever, to accomplish the speedy reduction of the viscera. The majority of them make no distinction between the *acute* and the *chronic* strangulation. In both cases, no sooner are the symptoms of strangulation evinced, than they begin to handle the swelling roughly, and to push the viscera with all their force, in order to make them return into the abdomen; whilst, when the strangulation is *acute*, and the patient young and strong, the taxis ought never to be practised, before all the means proper for diminishing the strength, calming spasm, and relaxing the parts, which are to be reduced, have been employed for a certain time. These means, we know, are bleeding, fomentations, emollient clysters, and especially the warm bath, which, next to bleeding, holds the first rank. At this school of surgery, I have frequently had opportunities of observing the salutary effect of this treatment. My pupils have, more than once, seen herniæ, which had been painfully handled without any good, reduced, as it were, spontaneously, after a bleeding, or whilst the patient was in the bath. If what I have said upon the subject of the *acute* strangulation, and the treatment that it requires, were generally known by surgeons, I think that operations for strangulated herniæ would be less frequent. Things are different, with regard to the *chronic* strangulation of old large herniæ, in feeble or aged persons; for, in these cases, it is of great importance to support the patient's strength. Bleeding, the warm bath, and other weakening means, should also be avoided; which, by producing a general atony, might bring on gangrene of the intestine, either during the strangulation, or after the reduction of the viscera. It is ascertained, that these kinds of strangulation are almost always occasioned by an accumulation of fecal matter, or an extraordinary quantity of air in the hernia. Nothing is more efficacious than cold applications, for promoting the action of the bowel on the matter, which distends it, or for lessening the volume of the air. They produce a corrugation of all the scrotum, and contractions of the cremaster, which alone sometimes suffice for reducing the viscera in a much better manner, than could be done by the hands of the most experienced surgeon." (*Scarpa, Traité des Hernies*, p. 244—247.) The advice of Mr. Guthrie respecting the taxis, is in exact accordance with that of Scarpa. (*On Inguinal and Femoral Hernia*, p. 23.)

Bleeding.—The inflammation, which attacks the protruded viscera, and spreads thence over the whole abdomen, and the temporary weakness and often fainting, which the sudden loss of blood induces, and which is a peculiarly favourable opportunity for reducing the hernia by the hand, are the reasons in favour of bleeding. Sharp, Pott, B. Bell, Sabatier, Richter, Callisen, Sir Astley Cooper, and Scarpa, names which can never be surpassed in respectability, are all in favour of bleeding. Wilmer and Alanson have published against the practice. By some mistake in the last edition, Sir Astley Cooper was enumerated amongst the opponents of bleeding: I feel it to be my duty, therefore, to correct this error by now inserting his valuable opinions on this point. If the taxis fail, other means must be tried. "One of them (says this distinguished surgeon) is venesection, the object of which is, first, by the general languor which it occasions, to produce a relaxation of the strictured part, and next, to prevent the local inflammation from running so high as to occasion mortification, which would render the case fatal, though the protruded parts were returned. The quantity of blood to be drawn should be from fourteen to twenty ounces, according to the strength of the patient's constitution. So much should be taken away as to bring on a degree of faintness, in which state of general relaxation, the attempts at reduction should be repeated. A surgeon, unaccustomed to the small thready pulse of a person suffering under strangulated hernia, feels apprehensive of taking away blood, conceiving the patient's strength to be fast sinking; but, this fear is groundless, as the pulse becomes larger and fuller after this evacuation." (*Sir Astley Cooper on Abdominal Hernia*, p. 32. ed. 2.)

Mr. Hey has related two cases, which strongly evince the manner in which bleeding facilitates the return of a hernia: the protruded viscera, in one instance, went up spontaneously, on blood being taken away; in the other, the taxis succeeded immediately afterwards, though the previous attempt had been made in vain. (P. 125, 126.) Mr. Hey's experience, however, leads him to concur so far with Wilmer and Alanson, as to declare, that bleeding has generally failed to procure a reduction of the strangulated intestine, though he is persuaded that, in many cases, it may be used with advantage. But he cannot agree with Wilmer, that it generally renders the subsequent operation more dangerous. (P. 126.) The majority of candid practitioners, I believe, will allow, that bleeding is always proper, when the hernia is small and recent; the abdomen tense and painful; and the patient young, strong, and plethoric.

In some old herniæ, where the symptoms depend upon mere detention of the intestinal matter, without any serious degree of compression of the bowel, and very little pain in the tumour itself, bleeding is not indicated. In these old and well-marked cases of the passive state of the abdominal opening, as Mr. Guthrie calls them, "Bleeding to syncope will only weaken the patient, and do little good. The warm bath will not be very effective, and tobacco enemata in elderly persons, are sometimes dangerous. The three principal remedies in recent herniæ, which have become strangulated, are here of little use, save as they act generally in reducing inflammation, because there is no muscular contraction to subdue; whilst, on the other hand, cold steadily applied may be of great service, when combined with such mechanical pressure as may be found advisable. In these cases, stimulating injections are of great use; and, if they be applied, as Mr. O'Beirne of Dublin advises, by means of a tube ten inches long, with a hole at the end of it, and introduced into the sigmoid flexure of the colon, the happiest results will follow, &c. It draws off the flatus, as well as the watery contents of the bowels, whilst the cold, acting on the tumour condenses the air in the incarcerated intestine, and tends to cause it to pass more readily into the abdomen." (*Op.* cit. p. 27.)

Purgative Medicines.—Mr. Hey's experience leads him to condemn almost universally the use of purgatives, while an intestine remains firmly strangulated. In the enteroepiplocele, when the intestine has retired, and the omentum remains strangulated; or in a simple strangulation of the omentum, where the intestine has not been prolapsed; he deems purgatives of great utility. So likewise in very large and old hernias, where there is reason to doubt, whether the disease is not to be considered as a morbid affection of the intestinal canal rather than the effect of strangulation, purgatives, he believes, may be as useful as in the simple ileus without hernia. While the intestine remains firmly strangulated, they usually increase the vomiting, and add to the distress of the patient. If they are to be tried at any time with hope of success, the trial would appear to have the greatest advantage when the vomiting has been removed by means of an opiate; yet Mr. Hey had repeatedly given them in vain during such an interval of relief. (*Practical Obs. in Surgery*, p. 128.)

Purgatives are supposed to operate by exciting the peristaltic action of the intestine, and thereby extricating it from the stricture. Not only Hey, but Pott and Richter have joined in their general condemnation. Sir Astley Cooper also disapproves of cathartics, except when the symptoms are very slight, and there is either no vomiting, or only at distant intervals. (*On Abdominal Hernia*, part i. p. 34. ed. 2.) Under these circumstances, he has known opium, joined with calomel and cathartic extract, produce stools, and relieve the patient.

Purgative clysters certainly have not the objection of increasing the irritation; but their efficacy is not deserving of much confidence. Mr. Hey never saw one case, in which either purgative or emollient clysters produced a return of a strangulated hernia. Such injections will empty the large intestines; but they do no more. It is common also for a natural evacuation to be the immediate consequence of strangulation. (P. 131.) Mr. Guthrie's opinions, with regard to cases likely to be served by stimulating clysters, have already been noticed.

Warm Bath.—Many instances (says Hey) are upon record of the good effect of warm bathing in procuring the reduction of a strangulated hernia. I have often seen it useful; but I have often seen it fail. Whenever it is used in this disease, the patient should be placed, if possible, in a horizontal position. Gentle efforts with the hand to reduce the prolapsed part are perhaps attended with less danger, and with greater prospect of success, while the patient lies in the bath, than inany other position. The free use of opiates coincides with that of warm bathing, and, under some circumstances, these means deserve to be tried in conjunction." (P.132.)

Cold Bath, and Cold Applications.—The cold bath, and dashing of cold water on the patient, are little to be depended on, though success has sometimes been obtained in this manner. (*Petit Mal. Chir.* t. ii. p. 325.; *Hey*, p. 136.)

Wilmer strongly recommended the application of cold to the tumour itself; and this plan has acquired the approbation of the most celebrated modern surgeons. It is sometimes tried in conjunction with the effect of tobacco clysters. Cold applications, in the form of ice, were indeed particularly recommended by B. Bell. The best way is to pound the ice, tie it up in a bladder, and place it on the rupture. Its effect is to lessen the pain, to make the skin over the tumour contract, and thus promote the return of the parts. When ice cannot be procured, Sir Astley Cooper employs a mixture of equal parts of nitre and muriate of ammonia. To one pint of water, in a bladder, ten ounces of the mixed salts are to be added. "If, after four hours, (says this distinguished surgeon), the symptoms become mitigated, and the tumour lessens, this remedy may be persevered in for some time longer; but, if they continue with unabated violence, and the tumour resist every attempt at reduction, no farther trial should be made of the application." (*On Inguinal and Congenital Hernia.*) When ice is not at hand, ether sometimes proves a good substitute, when allowed to evaporate from the surface of the swelling.

Care must be taken that the cold be not so applied as to freeze the scrotum, and bring on sloughing. (*Sir A. Cooper*, p. 15.) In large old herniæ, the application of ice is often attended with remarkable efficacy; and in other cases, as Sir Astley Cooper has explained, if it does not completely succeed, it arrests the progress of the symptoms. (*On Abd. Hernia*, part i. p. 34. ed. 2.)

Opiates.—Mr. Hey met with several cases, in which opiates, given freely (in athletic persons after bleeding), procured a reduction of strangulated hernia. He could not say, however, that this remedy was generally successful; but, it appeared to him to have the advantage of removing, for a time, the pain and vomiting usually attendant on strangulation, even though it proved ultimately inefficacious. Opiates should be given in large doses, when it is wished to try their effect in procuring reduction; and whenever the symptoms of strangulation return, after having been removed by opiates, the operation should be performed without delay. (P. 134, 135.)

Sir Astley Cooper states, that opium allays the vomiting, and, after venesection, promotes the reduction. (*On Abdominal Hernia*, part i. p. 34.)

Tobacco Clysters.—For this purpose, some surgeons prefer a decoction of tobacco, made by infusing, or boiling, one drachm of the plant, for ten minutes, in a pint of water; others employ the smoke, which is prepared, and introduced into the rectum, by means of an apparatus sold at almost every surgical-instrument-maker's. Perhaps both methods are equally efficacious; but as one requires an apparatus, while the other does not, and is equally proper, the decoction may be most entitled to recommendation. The machine for the smoke is also frequently out of order. Next to the operation, tobacco clysters are the most certain means of bringing about the reduction of the strangulated parts. Besides exciting the action of the intestines, they exert a peculiarly depressing influence on the whole system, reducing the pulse, and causing nausea and sickness, cold sweats, and fainting, under which circumstances, the parts often recede spontaneously, or may be easily reduced. Sir A. Cooper prudently advises injecting half the above quantity at first; for, he has seen two drachms, and even one, when used as an infusion, and introduced at once, prove fatal. (P. 24.) The rest should be injected presently, when it appears that the tobacco does not operate with the extraordinary violence with which it does in a few particular constitutions.

A case published by Sir C. Bell, looks to me very much like an example of the occasional poisonous effects of the tobacco. At least, no particulars of any fatal mischief, either in the tumour or abdomen, are detailed; and it is remarked of the patient, "His strength held up until the tobacco clyster was administered to him, after which he very suddenly fell low and sunk." (*Surgical Obs.* part ii. p. 189.) The smoke proved fatal in an instance witnessed by Desault (*Œuvres de Chir.* t. ii. p. 344.); and an infusion of ʒij. to ℥ viij. of water seemed to produce suddenly mortal effects in another example on record. (*Edinb. Med. and Surgical Journ.* vol. ix. p. 159.)

When the patient is old or considerably debilitated, the tobacco clyster should not be employed; for, if it fail, the constitution will not afterwards be in a state to bear the operation. I have known it succeed, however, in an aged person. A woman, above sixty years old, was brought to University College Hospital with a strangulated femoral hernia. The taxis and other means not having answered, I recommended the operation; but she obstinately refused to submit to it. As a last expedient, I directed the tobacco clyster to be employed, and, in half an hour, the hernia returned almost of itself. In another case, admitted into the same hospital, encouraged by the foregoing one, I tried the tobacco clyster for the relief of a strangulated femoral hernia in an aged female; but as the parts could not be reduced, I performed the operation; the sickness ceased; stools soon followed; and the pain and fever entirely subsided. But the weakness was such, that nature made little or no effort to heal the wound; the hernial sac sloughed, and the case ended fatally on the 6th or 7th day. This example, I should say, was against the employment of tobacco clysters in old persons.

Poultices and Fomentations have not the confidence of any experienced or intelligent surgeon. Whoever, in these urgent cases, wastes time in trying the effects of such applications, merits censure for his credulity, ignorance, and unfitness to undertake the treatment of a rapid disease, in which, as Pott remarks, if we do not get forward, we generally go backward; and whatever does no good, if it be at all depended upon, certainly does harm, by occasioning an irretrievable loss of time.

Of the Order, in which the preceding Methods should be tried, and of the Time when the Operation should not be delayed.

In the treatment of a strangulated hernia, a surgeon cannot be too deeply impressed with the danger of spending time in the trial of methods of inferior efficacy, or of such as are evinced to be ineffectual in the cases before them. The rapidity with which gangrenous mischief sometimes arises, and the patient loses his life, has been proved in a multitude of unfortunate examples, and should operate as a warning to all practitioners against the danger of deferring the operation too long. In the course of my reading, however, I have not met with so remarkable an instance of the sudden mortification, and rapidly fatal termination of a hernia, as the following case, recorded by Baron Larrey, in speaking of the fatiguing and forced marches performed by the French soldiers in Egypt. These marches, he says, brought on, in one case, "a hernia which formed suddenly, and became at the same time strangulated. The man was immediately brought to my ambulance; but, a spontaneous gangrene, which had all on a sudden attacked the intestine, and extended to the other abdominal viscera, caused the patient's death in the space of two hours, and made it impossible for me to do the operation for him. This is the second example, that I have been acquainted with, in which the effects were thus rapid." (*Mém. de Chir. Militaire,* t. i. p. 196.)

The taxis is generally among the first things to be tried; and Sir A. Cooper recommends the attempts to be continued for a quarter, or half an hour. When these have been ineffectual, the patient, if the circumstances do not forbid, should be immediately bled, and have a large opening made in the vein, so that the suddenness of the evacuation may be most likely to bring on fainting. The taxis should then be tried again.

When the strangulation is very *acute,* and the patient young and strong, perhaps, it may be most advisable to follow the advice delivered by Scarpa and Desault, which is, to bleed the patient, and put him in the warm bath, before the taxis is attempted at all.

If bleeding alone has been practised, and the manual efforts at reduction should not now succeed, the warm bath may be employed, *provided it can be got ready in a very short time,* but none should ever be lost in waiting for it to be prepared. When the bath is used, the taxis may be attempted, as the patient lies in the water; a situation, in which I have succeeded in reducing several herniæ.

Certainly not more than one hour should ever be allotted for putting in practice the first attempts at reduction, bleeding, and the warm bath.

The plan should be, while the trial of one thing is going on, another should be preparing; so when the preceding measures have been tried in vain, the application of a bladder filled with ice, or the solution of nitre and muriate of ammonia, and, if the patient be not aged, nor of too debilitated a constitution, the injection of tobacco, in the form of smoke or decoction, should never be delayed for want of due previous preparation of all the requisites. Both these measures should be practised at the same time, immediately after the failure of the taxis, bleeding, and the warm bath. Sir Astley Cooper computes, that four hours are enough for the trial of the tobacco clyster, together with cold applications.

In omental herniæ, the necessity for operating may frequently be obviated, by the good effects of bleeding, purgative medicines, and clysters, and leeches applied to the tumour. Mr. Lawrence has justly observed, that "when, as it very frequently happens, the aid of the surgeon is not required, until the complaint has lasted for some time, a trial of the tobacco, together with the topical use of cold, should be immediately resorted to, as circumstances will not admit of delay in the previous use of less powerful remedies." (P. 148. ed. 3.)

Every man who has seen much of herniæ, will immediately recognise the propriety of the following sentiments of the experienced Hey:—"I can scarcely press in too strong terms the necessity of an early recourse to the operation, as the most effectual method of preserving life in this dangerous disease. If Mr. Pott's opinion be true, that the operation, when performed in a proper manner, and in due time, does not prove the cause of death oftener than perhaps once in fifty times; it would undoubtedly preserve the lives of many, to perform it almost as soon as the disease commenced, without increasing the danger by spending much time in the use of means which cannot be depended upon for a cure. I have twice seen this disease prove fatal in about twenty-four hours. In such cases, it is evident there is little time for delay. A surgeon, who is competent to perform the operation, is not perhaps consulted till the intestine is on the point of being mortified, or is actually in a state of mortification. The dilemma into which he is then cast is painful indeed. But, when the fullest opportunity is afforded him of using the best mode of treatment, I am satisfied, that his success will be the greatest when the operation is not long delayed. This, at least, has been my own experience. When I first entered upon the profession of surgery, in the year 1759, the operation for strangulated hernia had not been performed by any of the surgeons in Leeds. My seniors in the profession were very kind in affording me their assistance, or calling me into consultation when such cases occurred; but we considered the operation as the last resource, and as improper until the danger appeared imminent. By this dilatory mode of practice, I lost three patients in five, upon whom the operation was performed. Having more experience of the urgency of the disease, I made it my custom, when called to a patient who had laboured two or three days under the disease, to wait only about two hours, that I might try the effect of bleeding (if this evacuation was not forbidden by some peculiar circumstances of the case) and the tobacco clyster. In this mode of practice, I lost about two patients in nine, upon whom I operated. This comparison is drawn from cases nearly similar, leaving out of the account those cases, in which a gangrene of the intestine had taken place.

"I have now, at the time of writing this, performed the operation thirty-five times; and have often had occasion to lament, that I had performed it too late, but never, that I had performed it too soon. There are some cases so urgent, that it is not advisable to lose any time in the trial of means to produce a reduction. The delay of a few hours may cut off all hope of success, when a speedy operation might have saved the life of the patient." (P. 141, &c.)

To determine the exact moment when to give up the trial of the preceding measures, and to have immediate recourse to the operation, is certainly difficult; but no one can doubt, that it is generally better to operate too early than too late.

All directions must be general ones, liable to many exceptions: in rapid cases, little or no time should be allotted to the trial of any plan; and the operation should be done without the least delay. In other instances, we have full time to try the effects of every thing at all likely to succeed. The symptoms, which ought to guide us, in having recourse to the operation, arise from an attack of inflammation in that part of the intestine contained in the hernial sac, and from its spreading into the abdominal cavity. It is in proportion to their violence, that we ought to urge the performance of the operation. Sir A. Cooper considers pain on pressing the belly, and tension, as the symptoms, which point out its immediate necessity. He adds, "indeed, there is scarcely any period of the symptoms which should forbid the operation; for, even if mortification has actually begun, the operation may be the means of saving life, by promoting the ready separation of gangrenous parts." (*On Inguinal and Congenital Hernia*, p. 27.)

According to Mr. Guthrie, if a patient is presented with a strangulated hernia, even one of recent formation, in whom the general symptoms are very severe, and *evidently from that cause*, the operation should not be delayed, although the tumour itself may be comparatively but little painful. "These general symptoms are, the pain at the umbilicus, the irritability of the stomach, the anxiety of countenance, and the failing state of the pulse. If in a young healthy man, strangulation had existed only four or six hours; the swelling were tense and painful, when touched; the nausea and sickness frequent; the pain at the umbilicus severe and increased on pressure; the pulse small and hard; the countenance distressed; Mr. Guthrie would be for the immediate performance of the operation. If the part were but little painful, and the umbilicus not acutely sensible, he would defer the operation until the effect of bleeding unto syncope, in combination with the hot bath, had been ascertained. Mr. Guthrie remarks, that a hernia of recent formation cannot remain in a state of incarceration ending in strangulation, for a longer period than ten hours, without placing the patient's life in great jeopardy." (*On Inguinal and Femoral Hernia*, p. 24.) I have sometimes operated directly, without expending time in the trial of any measure, but the taxis; of course, these were urgent and advanced cases.

Whenever the surgeon has succeeded in reducing the parts, without having recourse to the knife, if the symptoms of pain, inflammation, &c. ran high before such reduction, they will not always cease immediately afterwards. As they probably depend on the reduced bowel having been inflamed by the stricture, the body should be kept open, and the diet and regimen should be low and sparing, whilst the least degree of pain and tension remain; in short, till all complaint is absolutely removed from the abdomen, and the intestines do their office freely, and without trouble. (*Pott.*)

Symptoms of a Strangulated Hernia.

According to Sir Astley Cooper, one of the earliest symptoms of a strangulated hernia, is pain about the diaphragm, followed by continual eructation. The patient is next troubled with vomiting and costiveness. He feels a great inclination to have stools, but cannot succeed in his attempts to expel the feces. There is some pain in the swelling, and a great deal at the part where the stricture is situated. Afterwards the abdomen becomes considerably distended with air, such distension not arising from inflammation, but from the cause here mentioned, as is proved by pressure on the abdomen not giving at first any pain. The vomiting becomes more frequent, and feculent matter is ejected from the stomach; into which it is brought by what is called the antiperistaltic action of the bowels. A clyster will sometimes bring away a portion of feculent matter, but the quantity will be extremely small. While the abdomen is in this tense state, but unaccompanied with pain, and while there is frequent vomiting of the feces, the pulse is hard, frequent, and very distinct; but, in the next stage of the symptoms, when the abdomen is not only tense, but painful on being touched, the pulse is extremely small and frequent. The vomiting and eructations continue, and the patient is pale, and covered with a cold perspiration. The tumour becomes very tense, hard, and in general a little inflamed on the surface of the skin. With respect to the hiccough which now succeeds, and which has usually been considered as a sign of the presence of gangrene, Sir Astley Cooper declares, that it is now known not to be so, patients having had it for many hours, and yet recovered after the operation. The truth of this observation was exemplified in two instances, in which I have had occasion to operate. Hiccough sometimes continues several days after the operation. If the protruded parts be not now returned by means of the operation, or otherwise, "the tension of the belly, the restlessness, and fever having been considerably increased for a few hours, the patient suddenly becomes perfectly easy, the belly subsides, the pulse, from having been hard, full, and frequent, becomes low, languid, and generally interrupted, and the skin, especially that of the limbs, cold and moist; the eyes have now a languor and a glassiness, a lack-lustre not easily to be described; the tumour of the part disappears, and the skin covering it sometimes changes its natural colour for a livid hue; but whether it keeps or loses its colour, it has an emphysematous feel, a crepitus to the touch, which will easily be conceived by all who have attended to it, but is not so easy to convey an idea of by words; this crepitus is the too sure indicator of gangrenous mischief within. In this state, the gut either goes up spontaneously, or is returned with the smallest degree of pressure; a discharge is made by stool, and the patient is generally much pleased at the ease he finds; but this pleasure is of short duration, for the hiccough and the cold sweats continuing and increasing, with the addition of spasmodic rigors and subsultus tendinum, the tragedy soon finishes."

Anatomy of Inguinal Hernia.

This subject must necessarily precede the account of the operation, which would otherwise be unintelligible. It is chiefly in the anatomical information relative to hernia, and in the mode of operating, that modern surgeons have a decided superiority over their predecessors; for, before Gimbernat, Camper, Sir Astley Cooper, Hey, Lawrence, Scarpa, Hesselbach, Langenbeck, and Cloquet, published their several works on hernia, the anatomy of the disease was but imperfectly understood. Of all the eminent men, who have rendered our knowledge of the anatomy of hernia more correct, none has equalled Sir Astley Cooper in the number and importance of original observations. His description of the inguinal canal, the first accurate one ever given; his account of the fascia transversalis, (a texture which had not been contemplated, with reference either to anatomy, or disease, previous to his researches); his interesting observations on the muscularity of the internal ring; his description of the fascia propria of crural hernia; and an infinite number of pathological and practical facts; make Sir Astley Cooper the individual, whose labours, more than those of any other surgeon, have contributed to the advancement of this most important and difficult subject.

The tendinous fibres of the aponeurosis of the external oblique muscle, as they run downwards and forwards towards the pubes, separate from each other so as to leave a triangular opening, called the abdominal ring, which is usually more capacious in the male than the female subject. The upper and inner pillar (as it is termed) of this aperture is inserted into the symphysis of the pubes, and is the weakest of the two; the lower and outer one, which is the strongest, is chiefly a continuation of Poupart's ligament (*Hesselbach, über den Ursprung, &c. der Leisten-und-Schenkelbrüche*, p. 4.), and is fixed into the angle and crista of the same bone. Some tendinous fibres cross the upper and outer angle of the ring, so as to diminish the triangular appearance of the whole aperture: these are particularly strong in old herniæ. The anterior and thicker layer of the aponeurosis of the internal oblique muscle joins the tendon of the external oblique; the posterior and thinner one joins that of the transversalis; but the lower portion of this tendon, together with the corresponding part of the transversalis, goes wholly in front of the rectus muscle. Thus, the inferior border of the obliquus internus and transversalis, which originates from the upper part of Poupart's ligament, lies behind the outer pillar of the abdominal ring. Sir A. Cooper first noticed that a thin fascia proceeds from the inner edge of Poupart's ligament, and spreads over the posterior surface of the transversalis. This fascia forms a partition between the peritoneum and the outer opening of the abdominal ring; and were it not for its existence, inguinal herniæ would probably be much more frequent. In front of it are the aponeuroses of the internal oblique and transverse muscles. Hesselbach, who has named the small smooth point, situated directly behind the outer opening of the abdominal ring, its *crural surface*, distinctly states, that it is formed by delicate fleshy and tendinous fibres of the internal oblique muscle (*Ueber den Ursprung, &c. der Leisten-und-Schenkelbrüche*, p. 4.); and, that behind them is the weakest part of what he names the *internal inguinal ligament*, in the rear of which is the peritoneum, with the intervention of a very loose cellular substance. (*Op.* cit. p. 26.) The *internal inguinal ligament* of Hesselbach, is therefore clearly the same thing as the above fascia, first described by Sir A. Cooper. This point of the abdomen is one of the three weak places on the inside of the inguinal region, where herniæ are liable to occur; yet, weak as it appears to be, it is not the most common situation of such tumours. A computation has been made that, in a hundred cases of inguinal hernia, not ten occur at the point here specified. (*H. J. Brüninghausen, Unterrich* *über die Brüche, &c.* Wurzb. 1811.) Mr. Lawrence observes, that, if we trace the fascia transversalis from the crural arch upwards, we shall find it divided immediately into two portions, an internal and external, which leave between them a considerable interval just in the middle of the crural arch. The former of these, which is the strongest, and most decidedly fibrous, is connected by its inner edge to the outer margin of the rectus, and to the inferior margin of the tendon of the obliquus internus and transversus; and both are gradually lost above, between the peritoneum and transversus. (*On Ruptures*, ed. 4. p. 179.)

The spermatic vessels, joined by the vas deferens, run in front of the epigastric artery, very near the place of its origin. They then pass through the above fascia, go under the edge of the internal oblique and transverse muscles, and next obliquely downwards, and forwards, between the above fascia, and aponeurosis of the external oblique muscle, to the opening of the ring. When arrived on the smooth surface, immediately behind the ring, they describe an obtuse angle, and pass forwards and downwards into the scrotum. (*Hesselbach, Op.* cit. p. 5.)

Thus, the spermatic cord, before it actually emerges at what is named the abdominal ring, runs through a kind of canal, to which the epithet *inguinal* is often applied. This oblique passage of the cord, through the abdominal parietes, was well known to, and elegantly delineated by Albinus. Gimbernat makes distinct mention of it in his *Account of a New Method of Operating for Femoral Hernia*, p. 19. 32. But Sir A. Cooper has the merit of having given the earliest correct account of it, in reference to hernia; a subject rendered complete by the more recent elucidations of Hesselbach, Scarpa, Langenbeck, and Cloquet.

The abdominal ring is then only the outer opening of the canal or passage, through which the spermatic cord passes before it emerges. The inner one, at which the viscera first protrude, in the most common cases of inguinal hernia, is situated about an inch and a half from the abdominal ring, in the direction towards the anterior superior spinous process of the ilium; or, according to Sir Astley Cooper and Hesselbach, the inguinal canal is almost an inch and a half in length, the average distance of the outer pillar of the abdominal ring, from the inner pillar of what the latter terms the posterior ring, being about sixteen lines. (*Op.* cit. p. 14.) This inner opening is rather nearer the pubes than the ilium, and its upper border is formed by the lower edge of the internal oblique and transverse muscles, which can be plainly felt with the finger, introduced upward and outward into the abdominal ring. Mr. Guthrie, who is a believer in the muscular structure of the inner opening of the inguinal canal, as the general disposition, refers the difference of the symptoms of recent and old herniæ, when strangulated, to considerations founded upon this view. In the recent hernia, that is strangulated, the parts through which the protrusion happens seem to him to be comparatively but little altered, and the muscular structure of the internal ring capable of exercising great compression on the contents of the hernia, and often in a complete circle. Unless the pressure be removed, he observes, inflammation will soon follow, in consequence of the sharpness of the edges of the compressing parts, and the force with which they contract. "In recent herniæ which have become strangulated, in young and healthy persons, inflammation soon commences in the protruded intestine, and in the part which is above the stricture; and, if relief is not obtained, the intestine below mortifies, or ulceration takes place, or would take place, if time were given, immediately, or directly, above the part pressed on by the edge of the transversalis, or stricture. The patient, therefore, in a recent hernia dies of acute inflammation, followed by mortification, rather than of congestion, followed by low inflammation, and perhaps, although not always, mortification; which is the state of parts to be found usually in old herniæ, which have become strangulated. The symptoms correspond with the appearances found after death. In recent herniæ, when strangulated, there is pain in two distinct places; at the umbilicus, and extending from it to the pit of the stomach; and in the herniary tumor. In old herniæ, the pain is felt at first, and often for a long time at the umbilicus alone: the swelling shows little sign of derangement, and admits of considerable pressure being made upon it for several hours and even days after the incarceration and supposed strangulation are complete. (See *G. J. Guthrie, on Inguinal and Femoral Hernia*, p. 20.)

"The precise point, at which the hernia most commonly begins (says Scarpa), is that which corresponds, in the fœtus, to the communication of the tunica vaginalis with the peritoneum, and, in the adult, to the passage of the spermatic cord under the transverse muscle. In the sound state, the peritoneum presents at this part a small funnel-like depression, the depth of which increases in proportion as the spermatic cord is pulled from above downwards. It is this small pouch, this sort of digital appendage, whose progressive augmentation constitutes the hernial sac. Resting upon the anterior surface of the spermatic cord, it first makes its appearance under the inferior edge of the transverse muscle; thence it extends itself in the separation of the inferior fleshy fibres of the internal oblique muscle, always following the spermatic cord, in front of which it is situated; and, after having in this manner passed through the whole of the canal, which extends from the iliac region to the pubes, it lastly protrudes at its external orifice, which is the inguinal (or abdominal) ring, properly so called. In all this track the hernial sac, as well as the spermatic cord, is situated above the femoral arch, the direction of which it follows. The canal which it traverses is of a conical shape, the apex of which is towards the ilium, and the base at the external orifice of the ring." (*Scarpa, Traité des Hernies*, p. 44, 45.)

As M. Jules Cloquet observes, the inguinal canal is wider, and its apertures are much more distinct in the male, than the female subject.

The epigastric artery runs behind the spermatic chord, along the inner margin of the internal opening of the above canal, then upwards and inwards, so as to pass at the distance of half an inch, or an inch, from the upper extremity of the outer opening, or abdominal ring.

In common cases of inguinal hernia, the viscera protruded at the inner opening of the inguinal canal, lie over the spermatic cord, and form a tumor on the outside of the abdominal ring.

When the viscera have entered the above described digital pouch of the peritoneum, and the inguinal canal, but do not protrude through the abdominal ring, the case is sometimes termed, an *incomplete inguinal hernia ;* and *complete* when they pass out of that opening. The viscera may continue for a long while quite within the inguinal canal, and even become strangulated there: sometimes, also, they are prevented from passing further towards the ring by some kind of impediment; and, in this circumstance, if the hernial sac have any addition made to its contents, it may expand between the external and internal oblique muscles, as Hesselbach had an opportunity of seeing in the body of a female. (*Ueber den Ursprung, &c. der Leisten-und-Schenkelbrüche*, p. 28.) The stricture may take place either at the internal or external opening of the inguinal canal. In recent and small herniæ, according to Sir A. Cooper, the strangulation is most frequently situated at the inner opening; in large old ruptures at the abdominal ring. Even when the parts completely protrude out of the latter opening, the strangulation may exist at the inner one; but, there may occasionally be two strictures, viz., one at each opening. (See *Lawrence on Ruptures*, p. 183. edit. 3.)

In the foregoing part of this article, I have briefly adverted to the doctrine, that the internal ring is endued with muscularity. "The lower edge of the transversalis muscle (observes Sir Astley Cooper) has a very peculiar insertion, which I have hinted at in my work on hernia. It begins to be fixed into Poupart's ligament, almost immediately below the commencement of the internal ring, and it continues to be inserted behind the spermatic chord into Poupart's ligament, as far as the attachment of the rectus. Thus, the inguinal canal is endowed with muscular contraction, which under the action of the abdominal muscles, serves to close it, and lessen the propensity to hernia. Sometimes a portion of muscle descends from the tendon of the transversalis, in the course of the linea semilunaris, to be inserted into the fascia transversalis behind the chord, and into Poupart's ligament. It is this circular insertion of the transversalis, which is the cause of stricture in inguinal hernia, in the course of the canal, and nearly at the upper ring.

"Behind this insertion of the transversalis, the internal portion of the fascia transversalis appears, adhering strongly to the tendon of that muscle at the back of the inguinal canal.

"Thus, the inguinal canal is, at its anterior part, formed by the tendon of the external oblique; at its posterior, by the tendon of the transversalis, and by its folded muscular fibres; behind which is the fascia transversalis, into which those fibres are also inserted." (See *Obs. on the Structure and Diseases of the Testis*, p. 35. 4to. Lond. 1830.

Mr. Guthrie also describes the internal ring, or superior opening of the inguinal canal, as muscular; and he even supposed, that "the opinion, that this opening is in many instances a muscular one," was first advanced by himself in 1816. This claim cannot, however, be maintained against that of Sir Astley Cooper, who, in 1804, made the following observations with regard to the arrangement of the muscles at the internal ring:—"Hereby (says he) may be explained the opinion, which some surgeons have entertained of the *spasmodic* nature of the stricture,—a state which it was difficult to account for, when the seat of strangulation was supposed to be confined to the external ring, as this tendinous aperture possesses no muscular action, and cannot assume the state of spasm." (P. 28. part 1.) In another place, in noticing the means for reducing strangulated femoral hernia (Sir Astley Cooper remarks), "These means (tobacco and opium, &c.), are less frequently effectual here, than in the inguinal hernia, which is probably owing to two causes, namely, to the nature of the parts through which the hernia descends, and the smallness of the aperture forming the mouth of the sac. In the inguinal hernia, the parts are so connected with muscles, that any relaxation brought on in these, affects the aperture, through which the hernia descends; but, in crural hernia, the seat of the stricture is in parts less connected with the action of the muscles, and general relaxation has little effect on them." (Part ii. p. 9.) Mr. Swan, who attended Sir Astley Cooper's lectures in the winters of 1810-11 and 1812-13, heard him then explain, that the lower part of the transversalis muscle was the cause of stricture in inguinal hernia (See *Mr. Aston Key's Remarks in Lond. Med. Gaz.* 1833-34, p. 283.) As this gentleman observes, "if recent evidence be required, it may be found in Sir Astley Cooper's description of the cremaster " in his work on the *Testis*. In plate 5, fig. 1. is a view of the muscular structure in the inguinal canal; and the explanation of the plate says, 'C. C. transversalis muscle, arising from Poupart's ligament, and passing around the spermatic chord at the internal ring, so that the fibres of this muscle appear behind, as well as before the spermatic chord; and thus the inguinal canal is rendered a muscular canal.'" In explanation of plate 6. fig. 1. there is also the following note:—"Muscular fibres are always found proceeding from the transversalis, muscle upon that part of the fascia transversalis, which forms the posterior surface of the inguinal canal." The love of truth, then, obliges me to assign to Sir Astley Cooper the merit of this, as well as of numerous other original observations on hernia.

One question yet remains to be settled. Is the encircling of the spermatic chord by the fibres of the transversalis, only an occasional variety; or is it the ordinary condition of it? I know, that several lecturers on anatomy take the former view. (See *Lond. Med. Gaz.* 1833-34, p. 399.) M. Cloquet had seen the lower margin of the transversalis at a very considerable distance above the ring. He had also seen the spermatic chord enter the inguinal canal, passing between the fibres of the same muscle, which were only separated, without accompanying the chord, as those from the internal oblique do. These facts M. Cloquet manifestly speaks of, as deviations from what is most usual. M. Cloquet likewise notices another variety in the anatomy of the parts. "In the majority of subjects, (he observes) the spermatic chord passes underneath the lower border of the internal oblique, which it draws with it, to form the cremaster. In these cases, the anterior arches only exist, but in some individuals, it evidently traverses the fibres of this muscle; and these arches exist then not only in front, but also behind the testis and tunica vaginalis, which thus become everywhere surrounded by them." (See *Jules Cloquet's Description of the Parts concerned in Inguinal and Femoral Herniæ: translated by A. M. M'Whinnie*, p. 13.) On the same subject, Scarpa says, "The lower muscular fibres of the internal oblique, separate from each other to allow the spermatic chord to pass between them." (*On Inguinal and Scrotal Hernia*, p. 25., English ed.)

The hernial sac descends through the abdominal ring over the spermatic chord, and is covered by a fascia, sent off from the tendon of the external oblique muscle. Beneath this fascia, the cremaster muscle is also situated over the sac, which, after it has descended a certain way, lies on the tunica vaginalis, as well as the spermatic chord.

As the epigastric artery naturally runs first behind the spermatic chord, and then along the inner margin of the internal ring, and as the viscera are protruded over the chord, they must be situated on the outer side of the artery, which runs first behind the neck of the sac, and then on its inner side. Hence, the inner margin of the sac, when inspected on the side towards the abdomen, seems to be formed, as it were, by the track of the vessel. (See *Lawrence*, p. 179.) That this is the ordinary situation of the epigastric artery, in relation to the inguinal hernia, is confirmed by the concurrent testimonies of Camper, Chopart, Dessault, Sabatier, Sir A. Cooper, Hesselbach, Scarpa, &c., and by preparations to be seen in almost every museum.

In recent inguinal herniæ, the internal and external rings are at some distance from each other, the first being situated obliquely upwards and outwards in relation to the former; but, the pressure of the protruded viscera gradually forces the internal opening more towards the pubes, and nearer to the abdominal ring, so as to render the posterior side of the neck of the hernial sac, and of the inguinal canal, very short. (*Hesselbach*, p. 29.) Thus, in large herniæ of long standing, the opening into the abdomen is almost direct, and the epigastric artery becomes situated nearer the pubes than in the natural state.

Though such is the ordinary direction, in which a bubonocele protrudes, there are occasional varieties. In one of these, the viscera, instead of descending through the inguinal canal, are at once thrust through the abdominal ring itself, and the opening into the belly is then direct; the hernial sac, instead of passing on the external side of the spermatic vessels, as is usual, now lies on their inner or pubic side; and the epigastric artery, which is commonly situated behind, now pursues its course, in front of the sac, at its usual distance from the upper and outer angle of the abdominal ring.

The following is Scarpa's description of the displacement of the epigastric artery in the greater number of cases of inguinal hernia:—"This artery, which, in the natural state, runs about ten lines from the abdominal ring, has its situation and direction so changed, in subjects affected with hernia, that it crosses the posterior part of the neck of the hernial sac, and is pushed from the outer to the inner side of the abdominal ring. In order to comprehend the reason of this displacement, it is necessary to recollect what I have elsewhere said of the formation of inguinal hernia, and of the manner, in which the spermatic chord crosses the epigastric artery. The hernia begins to form at the very place, where the spermatic chord passes under the inferior margin of the transverse muscle; and this place is rather nearer the ilium, than that where the epigastric artery passes towards the rectus muscle. In its progressive extension, the hernial sac constantly follows the same track as the spermatic chord, since it is situated upon its anterior surface. As has been already explained, this chord crosses the epigastric artery; consequently, the hernial sac must necessarily pass with the chord above this artery; before protruding from the canal of the abdominal ring. At the same time, the internal orifice of the hernia becoming larger, and the inguinal canal shortened by the approximation of its two orifices to each other, it follows, that, at the period when the hernia begins to make its appearance in the groin, the epigastric artery is unavoidably situated behind the neck of the hernial sac, and is pushed from the outer to the inner side of the ring. Let us suppose a piece of string to be passed from the inside of the abdomen into the scrotum, all through the inguinal canal, and the middle of the hernia; and that this string is pulled so as to bring out the internal orifice of the hernia, which is situated beyond the point where the spermatic chord crosses the epigastric artery; this artery will immediately be found to be carried from the outer to the inner side of the neck of the hernial sac. The same thing happens from the effect of the enlargement of the hernia. The removal of the epigastric artery, from one side of the ring to the other (says Scarpa), is a phenomenon, which may be regarded as almost constant in the inguinal hernia. I have examined the bodies of a great number of subjects, affected with this species of hernia; and it has been only in a very few, that I met with the epigastric artery retaining its natural situation on the outer side of the abdominal ring. In investigating the reason of this exception, I have observed, in all the individuals who presented it, a very remarkable weakness and flaccidity of that part of the abdominal parietes, which extend from the ilium to the pubes. In all, *the displaced viscera had passed through the aponeurosis of the transverse and internal oblique muscles;* not in the vicinity of the ilium, as is commonly the case, but *at a little distance from the pubes,* giving to the upper pillar of the ring a curvature that is extraordinary, and disproportioned to the smallness of the hernia. I observed, also, that the neck of the hernial sac did not pass in an oblique direction, from the ilium to the pubes, but, that it protruded from the abdomen almost in a direct line from behind forwards. In short, in these individuals, the small cul-de-sac of the peritoneum, which constitutes the origin of the hernial sac, had not begun to be formed under the edge of the transverse muscle, at the point where the spermatic chord runs outward; but *it had passed through the aponeurosis of the internal oblique and transverse muscles, at a little distance from the pubes, and within the point at which the spermatic chord crosses the epigastric artery.* The small hernial sac, having at this part come into contact with and united to the spermatic chord, protruded at the external orifice of the inguinal canal, without displacing the epigastric artery from its natural situation.

"This species of hernia, properly speaking, is a mixture of the ventral and inguinal. It resembles the former, inasmuch as the hernial sac pierces the aponeurosis of the transverse and internal oblique muscles; the latter, inasmuch as it passes out at the abdominal ring, conjointly with the spermatic chord." (*Scarpa, Traité des Hernies*, p. 68, &c.)

Hesselbach particularly adverts to a *triangular* *space* to be seen on the inside of the inguinal region: the inner boundary of it is formed by the outer edge of the rectus muscle; the lower by the horizontal branch of the os pubis; and the external shortest boundary by the epigastric artery. Now, says he, when it is considered, that this artery ascends obliquely inwards, between the inner opening of the inguinal canal, and the above triangular space, one cannot fail to know on which side of the neck of the sac the artery must lie in the two species of inguinal, as well as the crural, hernia; for, in those herniæ which originate in the above triangular space, this artery lies at the outer side of the neck of the hernial sac; while in every hernia that takes place through the inner opening of the inguinal canal, the same vessel is situated at the inner side of the neck of the sac. To one species of bubonocele, Hesselbach applies the epithet *external*; and to the other, *internal;* according to the situation of the point at which they first protrude. By Sir A. Cooper, they are named *oblique* and *direct*, which are also very proper terms. The external inguinal hernia is much more frequent than the internal, and is said to occur oftener on the right than the left side of the body; a circumstance coinciding with another observation, viz. that, in children, the tunica vaginalis remains longer open on the right than the left side.

The circumstance of there being two forms of inguinal hernia formerly caused considerable perplexity: surgeons knew, that the epigastric artery lay sometimes at the inner, sometimes at the outer, side of the neck of the hernial sac, but knew not how to account for this variation. Hence arose the very different opinions about the proper method of dividing the ring when the hernia was strangulated; some authors directing the incision to be made obliquely inwards and upwards, and others, upwards and outwards. But, as a modern writer has judiciously remarked, had they paid greater attention to the direction of the swelling, formed by the neck and body of the hernial sac in the groin, and to the position of the spermatic chord, which is as inconstant as that of the epigastric artery; and had they dissected the parts in the diseased, as well as healthy state, they could not have failed soon to have suspected, that every inguinal hernia does not originate exactly at one and the same point. Though the internal bubonocele had been occasionally noticed by surgeons many years ago, and Mr. Cline, in particular, saw an example of it in the year 1777, and always mentioned it in his subsequent lectures, yet the earliest satisfactory history of the differences of the two forms of inguinal hernia was given by Sir A. Cooper, in his great work on hernia; and the tract, in which Hesselbach pointed out the nature of the internal bubonocele in a very particular manner, I believe is the next publication in which the subject is explained. (*Anat. Chir. Abhandlung über den Ursprung der Leistenbrüche,* Wurzb. 1806; and *Neueste Anat. Pathol. Untersuchungen über den Ursprung, &c. der Leisten-und-Schenkelbrüche,* 4to. Wurzb. 1814. p. 18. 26. 28., &c.) According to the latter author, since each form of inguinal hernia, also, presents characteristic appearances externally, the surgeon can have no difficulty in determining the species of hernia; which discrimination must be highly important in the taxis, the application of a truss, and especially the operation. The sac of the external scrotal hernia can only pass down within the expansion of the cremaster as far as this part is separate from the chord and tunica vaginalis. Hence, the testis, covered by its tunica vaginalis, lies under the lowest part of the hernial sac, while the vessels of the spermatic chord, in a more or less separated form, are situated behind the posterior part of the sac; viz. the spermatic veins externally, and the vas deferens internally, and the artery in the middle. Should the hernia descend still further, the testis being included as well as the sac within the tendinous expansion of the cremaster, it cannot glide out of the way, but must be pressed still further downwards by the sac, so as to continue invariably under its fundus, but sometimes inclined a little behind it. (*Hesselbach,* p. 34.) And, as the same author justly observes, the position of the spermatic chord and testis, and the oblique direction of the swelling in the external species, are the two strongest characters, by which every case of inguinal hernia may be discriminated. I know of only one direct case, in which the chord was behind the sac, as in the common external bubonocele: it was seen by Mr. Lawrence. (*On Ruptures,* p. 210. ed. 4.)

Although the spermatic chord, in the external bubonocele, commonly lies behind, or under, the hernial sac, there are cases in which the vas deferens is found on the outer side of it, while the rest of the spermatic chord lies, as it usually does, on the inner side, or rather under it. (*Sir A. Cooper.*) Le Dran, Schmucker, and Blizard, found the whole chord situated in front of the sac. Sometimes the vas deferens runs on the front and inner part, and the rest of the chord on the back and external part of the swelling. (*Camper, Hey.*) The chord has been known to be before, and the vas deferens behind, the sac. (*Camper, Sir A. Cooper.*)

Upon this part of the subject, the reader may deem the following passage interesting: —"While the hernia is of moderate size (says Scarpa), the surrounding cellular substance is not very greatly compressed, and no change is observed in the situation of the spermatic vessels. The artery and veins of this name always form, with the vas deferens, one single chord, which is intimately adherent to the posterior surface of the hernial sac. But, in proportion as the tumour increases in size, the cellular substance, which immediately surrounds it and unites it to the spermatic chord, is more and more distended and compressed. At length, at a certain period, the distention is carried to such a pitch, that the spermatic vessels are separated from one another, and change their position with respect to the hernial sac. This kind of gradual unravelling of the spermatic chord is quite similar to that, which would be produced by pulling the surrounding cellular substance in two opposite directions. Such is the reason, why, in scrotal hernia of large size, the spermatic artery, the vas deferens, and the spermatic veins, are found separated upon the posterior surface of the sac. All these vessels, instead of being conjoined in one chord, are divided by interspaces, which are sometimes very considerable. Ordinarily, the vas deferens is less separated from the spermatic artery, than from the vein of this name. In some subjects, Camper has seen it situated on one side of the sac, and the artery and veins on the other (*Icones Herniarum,* tab. v. *L. O.* tab. viii. 1. 2.) The displacement and splitting of the spermatic chord take place equally in adults and in children affected with large scrotal hernia. (*Camper*, loco cit.) In general, towards the upper part and neck of the hernia, the vessels are not much separated; but, as they proceed downwards, they diverge more and more. Sometimes, when the hernia is very old and bulky, they are no longer found at the posterior part, but rather at the sides, and even on the front surface of the sac; they show themselves through the cremaster muscle, which covers them, and form a kind of vascular train, which arrests the hand of the operator at the moment when he is about to open the hernial sac. Le Dran relates, that, in operating upon a large scrotal hernia, he found the spermatic chord on the anterior surface of the hernial sac. (*Opérations de Chir.* p. 127.) This fact has been the cause of numerous conjectures, and has appeared altogether inconceivable to such surgeons, as have not been acquainted with the changes, to which the spermatic chord is exposed, in cases of large scrotal herniæ. Lassus could not (*Méd. Opérat.* t. i. p. 152.) conceive the possibility of the occurrence. The observation of Le Dran is not the less true and exact: it exemplifies a very important fact, of which it is easy to give a true explanation, when the state of the spermatic chord, in ordinary inguinal herniæ, and in those which have obtained a considerable size, has been comparatively examined. In the first, the spermatic chord, quite entire, is always situated on the posterior surface of the hernial sac; but, in the second, the spermatic vessels are so separated from one another, that they sometimes extend over the sides and even the fore part of it.' (*Scarpa, Traité des Hernies*, p. 61., &c.)

When an oblique inguinal hernia is dissected, a fascia, of greater or less thickness, is found immediately under the skin and *superficial facia:* it is often termed the *intercolumnar fascia.* Under this is *the covering produced by the cremaster.* When the *integuments, superficial* and *intercolumnar fasciæ,* and the *cremasteric covering,* have been removed, another investment is exposed, derived from the fascia transversalis, where it forms the internal ring, and called by M. Jules Cloquet, the *funnel-shaped sheath.* Within this is the hernial sac itself, composed of peritoneum.

It is observed by Professor Scarpa, that "the cremaster muscle, in cases of old large scrotal herniæ, acquires a thickness, which is really surprising. Its fibres, which are natually very thin, become from four to six times more considerable. Being spread over the neck and body of the hernial sac, they sometimes present a remarkable consistence, and a yellowish colour. Such alteration, however, does not prevent the muscular texture from being discovered; and Haller was not mistaken about it." (*Opusc. Patholog.* p. 317.) Pathology furnishes us with several examples of similar changes of organisation. In certain cases, the muscular coat of the bladder, that of the stomach and intestines, and even the exceedingly delicate fleshy fibres of the ligaments of the colon, are found to have become yellow, and much thickened.

In old scrotal herniæ (says Scarpa) it is not unusual to find an intimate adhesion of the fibres of the cremaster muscle to the edges of the abdominal ring. This may depend on the pressure, which the contents of the hernia make on those edges, and perhaps it may also depend on the union of the cremaster muscle with the prolongation of the aponeurosis of the fascia lata, which is continued from the margins of the ring to the groin and scrotum, Howsoever it may be, certain it is, that in old large scrotal herniæ, there is much difficulty in introducing a probe between the fleshy fibres of the cremaster and the margin of the abdominal ring; and that, on the contrary, in recent herniæ, a probe passes as easily between the edges of the ring and the cremaster, as between this muscle and the hernial sac.

With regard to the sheath, formed by the cremaster muscle, in which are inclosed the hernial sac, the spermatic chord, and the tunica vaginalis of the testicle, Sharp (in *Critical Inquiry*) and Monro, the father, (*Anat. and Chirurg. Works*, p. 553.) were the first to dwell upon this important pathological point. Monro had seen the cremaster muscle covering the hernial sac; but, he did not believe, that the same thing occurred in all individuals affected with inguinal hernia. In this respect he was mistaken; for this disposition of the cremaster muscle is one of the essential characters of the disease. Petit has not omitted to describe the relations, which exist between the cremaster and the hernial sac. (*Œuvres Posthum.* t. i. p. 288.) On this subject, he even relates an interesting fact, from which it results, that, in certain cases, this muscle may, by its contractions alone, cause a reduction of the hernia; a fact also noticed by M. Jules Cloquet. (*On Inguinal and Femoral Hernia*, tr. *by M'Whinnie*, p. 10.) Gunz explains, with tolerable perspicuity, how the cremaster and its aponeurosis form one of the coverings of the inguinal and scrotal hernia. (*Libellus de Herniis*, p. 50.) Morgagni once saw its fleshy fibres extended over the hernial sac. (*De Sed. et Caus. Morb.* epist. xxxiv. art. 9.; epist. xxxi. art. 15. See *Scarpa, Traité des Hernies*, p. 48, 50.)

Scarpa concurs with Sir Astley Cooper, respecting the fact of the peritoneal hernial sac not being in general perceptibly thickened. In a very enormous hernia, the pressure of the contents is so great, that instead of thickening the sac, it renders it thinner, and even makes it ulcerate. The protruded viscera have been met with immediately beneath the integuments, when the sac has been burst by a blow. (*Cooper, J. L. Petit.*)

The outer surface of the peritoneal part of the hernial sac, is always most closely adherent to the other more external covering, by means of cellular tissue. This connection is formed so soon, after the first occurrence of a hernia, that any chance of returning a hernial sac into the abdomen has generally been considered as chimerical. There must, however, be a certain space of time before adhesions form, though it must be exceedingly short. Upon this point Scarpa observes, that in recent and small inguinal herniæ, the intestine, strangulated by the neck of the hernial sac, has been known, in more instances than one, to have been reduced by the taxis, and carried with it the whole of the sac into the abdomen. Observations, not less authentic, inform us, that, after the operation for hernia, when the viscera could not be reduced on account of their adhesions to the sac, they have been seen, notwithstanding such adhesions, to get nearer to the ring daily, and, at length, spontaneously to return into the belly together with the hernial sac. M. Louis, he thinks, was wrong in denying the possibility of these facts. (*Acad. Royale de Chir.* t. xi. p. 486.)

Scarpa argues, that, "under certain circumstances, the cellular tissue will bear, without laceration, a considerable elongation, and afterwards shrink again. Thus, we often see a viscus, which has suffered a considerable displacement, return spontaneously into its natural situation. In inguinal hernia, the spermatic chord is elongated, and descends farther than in the natural state. No laceration of the cellular tissue, however, is then occasioned; for, if the hernia be kept reduced, the spermatic chord becomes shorter, daily retracts, and at last, has only the same length, which it had previously to the disease. When a sarcocele becomes large and heavy, the portion of the spermatic chord naturally situated within the belly, is by degrees drawn out into the scrotum; but, after the tumour is extirpated, this portion ascends again, and of itself returns into its original situation. The same thing happens after the operation for strangulated inguinal hernia. The hernial sac retracts and reascends progressively towards the ring. This alone would prove, that the cellular tissue which surrounds the spermatic chord, and unites it to the hernial sac, is highly endued with the property of yielding, and afterwards returning to its original state. Can the same property be refused to the cellular tissue which unites the sac to the surrounding parts?

"While the inguinal hernia is recent, and not of much size, the cellular tissue in question possesses all its elasticity, and hence, the hernial sac and the spermatic chord may easily ascend towards the abdominal ring. I have had occasion (says Scarpa) to make this observation upon the dead body of a man, who had an incipient inguinal hernia. The small hernial sac was capable of being pushed back into the ring with the utmost facility; and in carefully examining the parts, both within and without the belly, it appeared to me, that the cellular substance, which united the sac to the spermatic chord and cremaster muscle, was disposed to yield equally from without inwards, and in the direction precisely opposite; that is to say, it made an equal resistance to the protrusion and the reduction of the hernial sac. Monteggia has seen a case exactly similar; although, according to his own expressions (*Instituz. Chirurg.* t. iii. sec. 2. p. 249.), the hernial sac was not very small, it adhered very loosely to the surrounding parts, and it admitted of being entirely reduced into the abdomen with great facility."

In large old scrotal herniæ, Scarpa allows, that such reduction is quite impracticable:—"In these, the cellular tissue which unites the sac to the spermatic chord and cremaster muscle, has acquired such a density, that it does not oppose less resistance to the further enlargement of the hernia, than to the efforts of the surgeon who endeavours to effect its reduction." (*Scarpa, Traité des Hernies*, p. 57, &c.)

In the dead subject, Cloquet found the sac of a direct inguinal hernia reduced into the abdomen, whither it seemed to have been drawn by a piece of omentum adherent to what had, in its protruded state, been its fundus. (*Recherches sur les Causes, &c. des Hernies*, p. 102.) The investigations of the same author prove, that complete or incomplete inversions of the sac may also happen in the femoral and direct inguinal hernia, without the existence of any adhesion; but that the intimate union between the sac and spermatic chord hinders the event in external or common inguinal ruptures. Le Dran dissected a case, in which the sac of a femoral hernia, with its contents, had been returned into the abdomen in a mass. Dupuytren saw a similar case. (*Clin. Chir.* t. i. p. 559.) And in another place, he states, that he had seen forty instances of herniæ being returned in a mass, without any abatement of the bad symptoms. (P. 564.) The observations of Cloquet also tend to confirm the possibility of the latter occurrence, which he describes as happening with more facility in the internal or direct inguinal rupture, than in the crural, and with most difficulty in the external or oblique inguinal hernia.

In females, when a bubonocele occurs (which is uncommon), the round ligament of the uterus bears the same relation to the tumor, as the spermatic chord in males. According to Sir Astley Cooper, the sac is much more considerable above the abdominal ring than below it; and hence difficulty in the operation. All the cases which he has seen have been intestinal. The stricture is, in almost all cases, at a considerable distance above the abdominal ring; it may be divided upwards, or outwards, with safety, as the epigastric artery is situated more towards the linea alba. (See *Lancet*, vol. ii. p. 172.)

Mr. Lawrence had a very rare instance pointed out to him, in which a bubonocele in a female was situated on the inner side of the epigastric artery. On the 12th of March, 1831, I operated upon Mrs. Smith, of No. 14, Cumberland-street, Middlesex Hospital, for a strangulated internal bubonocele: she recovered in the most favourable manner. A still rarer case was examined by Hesselbach: it was not only an example of internal bubonocele in a woman, but of one in which the epigastric artery arose from the obturatrix artery an inch from the origin of this latter vessel from the inner side of the external iliac; the obturatrix first passed an inch obliquely downwards and inwards over the crural vein, and immediately afterwards, on the horizontal ramus of the pubes, made a sudden turn backward and downward to the obturator foramen; and at this bend arose the epigastric artery, which ran transversely inward along the horizontal ramus of the pubes, behind the neck of the hernial sac, at the inner side of which it ascended to the rectus muscle, accompanied by the ligamentous remains of the umbilical arteries, which were close behind it. (*Ueber den Ursprung, &c., der Leisten-und-Schenkelbrüche*, p. 17.)

Marks of Discrimination between Inguinal Herniæ and other Diseases.

The disorders in which a mistake may possibly be made, are *Varicocele, Bubo, Hydrocele,* and *Hernia Humoralis,* or *Inflamed Testicle.*

For an account of the manner of distinguishing the first complaint from a bubonocele, see Varicocele.

"The circumscribed incompressible hardness, the situation of the tumour, and its being free from all connection with the spermatic process, will sufficiently point out a bubo, at least while it is in a recent state; and when it is in any degree suppurated, he must have a very small share of the *tactus eruditus*, who cannot feel the difference between matter, and either a piece of intestine, or omentum.

"The perfect equality of the whole tumour, the freedom and smallness of the spermatic process above it, the power of feeling the spermatic vessels and the vas deferens in that process, its being void of pain upon being handled, the fluctuation of the water, the gradual formation of the swelling, its having begun below and proceeded upwards, its not being affected by any posture or action of the patient, nor increased by his coughing or sneezing, together with the absolute impossibility of feeling the testicle at the bottom of the scrotum, will always, to an intelligent person, prove the disease to be a hydrocele." The transparency of a hydrocele is also another criterion. Mr. Pott, however, allows that there are some exceptions, in which the testicle cannot be felt at the bottom of the scrotum, in cases of hernia. "In recent bubonoceles, while the hernial sac is thin, has not been long, or very much distended, and the scrotum still preserves a regularity of figure, the testicle may almost always be easily felt at the inferior and posterior part of the tumour. But, in old ruptures, which have been long down, in which the quantity of contents is large, the sac considerably thickened, and the scrotum of an irregular figure, the testicle frequently cannot be felt, neither is it in general easily felt in the *congenital hernia* for obvious reasons."

On one point, Sir Astley Cooper differs from Mr. Pott. "The hydrocele," he observes, "involves the *spermatic chord* and testes, so as to render them with difficulty distinguished by the touch; whilst, in hernia, they may in general be readily felt behind the tumour." The discrepancy may be reconciled by supposing that one of these eminent surgeons is speaking of a hydrocele of great size, which obscures the chord and that the other is alluding to the disease in a less advanced stage. Sir Astley Cooper has seen cases of hydrocele, "in which there was unusual difficulty in deciding upon the nature of the complaint. When it becomes so large as to extend upwards through the abdominal ring to the abdomen, the form of the tumour is precisely the same as that of hernia; and it even dilates when the patient coughs, owing to the sudden pressure upon that part of it which lies above the ring. The transparency, the fluctuating feel, and the observed progress of the swelling from below upwards, are then the only distinguishing marks.

"A tumour sometimes appears in the scrotum, which descends in the erect posture, returns when the body is recumbent, distends upon coughing, fluctuates, and is transparent. This disease is a collection of water, which runs backwards and forwards, between the cavity of the abdomen and that of the tunica vaginalis, owing to the opening of this membranous sheath never having been closed. When this disease is complicated with ascites, the part becomes distended to an enormous size. It is readily distinguished from a hernia by its transparency and fluctuation." (See *A. Cooper on Hernia*, part i. p. 16. ed. 2.)

Hydrocele of the spermatic cord is another case still more likely to be mistaken for a hernia than the common form of hydrocele. See HYDROCELE. When situated entirely below the ring, its want of connexion with the abdomen makes it readily distinguishable from a hernia; but when it passes within the ring to the abdomen, some difficulty occurs in understanding its nature. If there is no transparency, and the fluctuation is indistinct, the surgeon should be very cautious in operating on such a tumour.

Sir Astley Cooper was requested to see a boy, who had a tumour, extending from the upper part of the scrotum through the abdominal ring, along the chord to the abdomen; but it did not project sufficiently to enable Sir Astley to judge whether there was either fluctuation or transparency. However, as the tumour interfered with the boy's pursuits, he cut down upon it with extreme caution. When he had reached the surface of the cyst, he found the spermatic vessels running upon it, and was obliged to open the lateral portion of the cyst to avoid them. This sac contained a piece of small intestine, every where adherent to its inner surface, so as to have prevented reduction. The vas deferens was felt behind the sac. The hernia had, therefore, insinuated itself between the spermatic blood-vessels and the vas deferens. (See *A. Cooper on Hernia*, ed. by *C. Aston Key*, part i. p. 61.)

Dr. J. B. Davidge, late professor of anatomy in the University of Maryland, had frequently been consulted by persons who had been wearing trusses for years, while their disease was merely hydrocele of the chord; and, in one case, the sac had been burst by the violent efforts made to reduce it. Dr. Reese of New York, has also known this mistake committed in several instances. In another, a surgeon, deceived by such a hydrocele happening to be attended with long and obstinate constipation, nausea, vomiting, hiccough, abdominal distention, pain in the tumour, &c., dissected down to what he supposed to be the hernial sac, and divided the tendon of the external oblique, when the hydrocele gave way and its contents were discharged. (Amer. ed. *of this Dict.*) It seems extraordinary that the surgeon in this case should have divided the abdominal ring, before he had opened the sac, or ascertained the situation of the stricture, so as to know whether the tendon of the external oblique required to be cut or not. The operation of opening the cyst of the hydrocele, though performed unawares, was only a common method of cure, and, in fact, ended in it. The manner of proceeding I am unable to account for, unless it was intended to try Petit's plan of cutting the stricture and reducing the hernia, without opening the peritoneal sac at all.

In the *hernia humoralis*, the pain in the testicle, its enlargement, the hardened state of the epidydimis, and the generally preceding gonorrhœa, are circumstances fully elucidating the diagnosis. The observation of Pott, that in inflammation of the testicle, the spermatic chord is exempt from all unnatural fulness, is not correct. I have known it enormously swollen and accompanied by obstinate constipation and vomiting; indeed, the swelling, when the case arises from gonorrhœa, mostly commences in the chord. "Nothing," says Sir Astley Cooper, "but great want of attention can cause a hernia to be confounded with an enlargement of the testis. This latter is sufficiently distinguishable, not only by the absence of symptoms, characterising hernia," but also by the form of the gland, its weight, the pain, and that peculiar and intolerable sensation always produced by pressure on this organ. (*Obs.*)

Hæmatocele is recognised from a hernial tumour by adverting to its cause, which is a wound or contusion of the scrotum; its firmness; the attendant dark redness of the skin; its freedom from impulse when the patient coughs, and of the upper part of the chord from swelling. (*Sir A. Cooper*, ib.)

Hernia may be complicated either with hydrocele, or sarcocele. Sir A. Cooper mentions an instance in which there was on each side a diseased testicle, and a hydrocele communicating with the abdomen. (*On Hernia*, ed. 2. part i. p. 17.) See Hydrocele.

Inguinal Hernia within the Canal.

When the parts only protrude into the inguinal canal, and not out of its lower aperture, they are covered by the aponeurosis of the external oblique muscle. The transverse and internal oblique muscles pass over the neck of the hernia, and cause the strangulation when it happens. The tumour is small; for, if the protrusion increases, the parts escape through the lower opening of the canal. Exceptions, however, are on record. Thus, Mr. Lawrence dissected a case in a female, where the aponeurosis of the external oblique was distended by a swelling equal in bulk to two fists, while another portion of the sac, as large as an egg, projected through the ring. Hesselbach's 8th plate also represents a hernia within the canal, of considerable size, in a female. As, in the ordinary circumstances of this form of inguinal hernia, there is no very manifest swelling, the case is no doubt often looked upon and treated, as Sir Astley Cooper remarks, as an inflammation of the bowels. (*On Inguinal and Congenital Hernia*, p. 48.)

When an inguinal hernia does not descend through the abdominal ring, but only into the canal for the spermatic chord, it is covered by the aponeurosis of the external oblique muscle, and the swelling is small and undefined.

Now and then, the testicle does not descend into the scrotum till a late period, and its first appearance at the ring, in order to get into its natural situation, may be mistaken for a hernia; unless the surgeon pay attention to the absence of the testicle from the scrotum, and the peculiar sensation occasioned by pressing the swelling.

Points of difference between the external and internal Inguinal Hernia, &c.

According to Hesselbach, the characteristic marks of the external bubonocele and scrotal hernia, are: 1st. The direction of the tumor in the groin. 2dly. The fleshy fibres of the cremaster. 3dly. The position of the spermatic chord and testis. 4thly. The situation of the epigastric artery. 5thly. The origin of the hernia itself. 6thly. A preternatural shape of the body of the hernial sac.

1. The neck of the hernial sac, distended by the protruded viscera, raises up the front side of the inguinal canal, and superincumbent integuments, into an oblong swelling, which extends obliquely inwards and downwards towards the abdominal ring, and terminates in the tumor, formed by the body of the hernial sac. From its origin it becomes gradually more prominent and broad; and the greater the quantity of viscera protruded, and the larger the body of the sac, the more manifest is this oblique swelling, particularly when the neck of the hernia is of its natural length. In strangulated cases, the direction of the tumor is still more striking, every part of the hernial sac being then considerably distended. When the inguinal canal, and of course the neck of the hernial sac, are shortened, the swelling undergoes a proportional diminution in its length; and then its resemblance to the tumor attending an internal inguinal hernia, where the opening through which the parts pass is long and slanting, is so great, that the cases can only be discriminated by one circumstance, viz., the situation of the spermatic chord; and even this criterion is of course wanting in females. (*Hesselbach*, p. 57, 58.) Hesselbach clearly explains, that the obliquity of the swelling is seated in the neck of the hernial sac. He observes, that when an internal bubonocele in a female subject passes into the labium, the descent takes place in a very sloping direction inwards, and therefore may at first be supposed to be an external case. But, on further examination, the oblique swelling will be found to occupy the body of the hernial sac, and to reach upwards and outwards from the labium to the abdominal ring. Now, this hernia cannot be mistaken for an external bubonocele, the course of which from the ring is obliquely upwards and outwards. As Sir Astley Cooper has remarked, if there be any obliquity of an internal or direct inguinal hernia, it will incline towards the linea alba.

Hesselbach reminds us, that an internal inguinal or scrotal hernia may be conjoined with an external incomplete bubonocele; a kind of case easily made out with a little attention; for the place of division between the two sacs is indicated by a more or less deep groove. The nature of the disease will also be still clearer, if one of the tumours admit of reduction. A specimen of such a double hernia is to be seen in the museum at Würzburg.

It is further noticed by Hesselbach, that when the situations of the external and internal herniæ are compared, the first of these swellings will be found to be rather further than the other, from the symphysis of the pubes; a difference ascribed to the effect of the internal oblique muscle, the lower fibres of which, attached to the horizontal ramus of the pubes, run in a curved direction transversely over the anterior and inner part of the neck of the hernial sac, and are applied so closely to it, that it cannot approach quite so much towards the symphysis of the pubes, as the neck of the internal bubonocele does. The muscular fibres in question are situated directly behind the inner pillar of the abdominal ring.

2. Most of the fibres of the cremaster lie on the back of the neck of the sac, but others are also scattered over its external and internal sides. Some fibres may also be perceived on its fore part, which are remarkable, because they run in a transverse curved direction with their convexity downwards, and two fasciculi of which descend below the abdominal ring. These are the fibres of the cremaster, which proceed within the ring transversely upwards over the spermatic chord, and are pushed out of that opening by the hernial sac. These arched fleshy fibres are not always, though generally, perceptible; and, when they are present on the fore part of the hernial sac, Hesselbach accounts them a sure criterion of an external scrotal

hernia; but, he has not yet ascertained, whether they are visible, while the rupture is confined to the groin.

3. The spermatic cord passes behind the oblique hernia, and not on the outer side of it, as in a direct case.

4. The situation of the epigastric artery, and its displacement inwards by the neck of the sac, of an oblique hernia, have been sufficiently explained.

5. With respect to the mode in which the oblique hernia originates, the disease sometimes takes place suddenly, without any exciting cause being observed, capable of accounting for the effect. Here, says Hesselbach, the predisposing cause must have been great. In this quick manner, the congenital hernia, which is one of the oblique cases, frequently arises. The direct inguinal hernia is observed mostly to take place very suddenly, yet only after violent occasional causes. Sir Astley Cooper records two cases from external violence: one in a gentleman who received a blow on the groin in riding; the other in a boy, in consequence of a kick from his schoolmaster. In the greater number of cases, he has found the direct inguinal hernia accompanied by diseases of the urethra. "One of the specimens (says he) in my possession, contains six herniæ of this kind." After death, several strictures were met with in the urethra, behind one of which a stone was impacted. (*On Abdominal Hernia*, part i. p. 67.)

6. A preternatural form of the body of the hernial sac, Hesselbach remarks, is particularly seated in the sheath of the spermatic cord, and can never happen in the internal or direct scrotal hernia; for, it is only in oblique cases, that the above sheath is ever converted into the hernial sac. Hesselbach here refers to the partial contraction, often noticed at the lower part of the above sheath in cases of congenital hernia; a circumstance, which is always discovered previously to the business of dividing the ring.

In adults, an oblique inguinal, or scrotal hernia, on the right side, contains some of the ileum, and, when the swelling is large, it may include the cœcum, and sometimes a piece of omentum. In one child, ten weeks old, and in another still younger, the appendix verniformis was protruded and connected by a natural band to the posterior side of the peritoneum. When, in these ruptures of the right side, the cœcum, or, in those of the left, the colon, are met with closely adherent to the hinder side of the hernial sac, the adhesion is not to be looked upon as the effect of disease, since it is the perfectly natural connection of those bowels with the peritoneum. On the left side, the parts most commonly protruded, are the colon and omentum.

With regard to the *internal*, or *direct inguinal hernia*, the place of its first protrusion has been already described. The protruded peritoneum and viscera, according to Hesselbach's account, *pass from behind straight forwards*, between the fibres of what he names the internal inguinal ligament, and the fleshy fibres of the internal oblique muscle: they then pass, at the inner side of the spermatic cord, out of the abdominal ring, where the hernia presents *a circular globular swelling, suddenly formed in consequence of some violent effort*. The neck of the hernial sac is very short; shorter, than it can ever be in an oblique inguinal hernia; and, when the tumour is of the above shape, the passage through which it passes is angular, narrower in some instances, than others, and its margin is tendinous. Sir Astley Cooper has never known it acquire a size equal to that which the oblique inguinal hernia sometimes attains. (*On Abdominal Hernia*, part i. p. 67.) From the few cases, which Hesselbach has seen of this form of the disease, he is also led to believe that the hernial sac is rarely so large as in the oblique inguinal hernia. (P. 41.) According to Sir Astley Cooper, the direct inguinal hernia occurs when the tendon of the transversalis is unnaturally weak, does not exist at all, or has been broken. (*On Inguinal Hernia*, p. 51.) Cloquet states, that the sac either propels before it, and thus receives a covering from the fascia transversalis, or passes through an opening in it. (*Recherches Anat.* p. 83.) In another work, he gives the particulars of a direct inguinal hernia of the right side, where the protrusion took place through a laceration in the fascia transversalis. (*Pathologie Chirurgicale*, p. 126.) Mr. Lawrence dissected a case, where the fascia was neither thinner than usual nor broken, but it had been protruded before the peritoneum, and formed a thick aponeurotic covering to the hernial sac. Mr. Stanley has always found it thus covered; and some specimens, illustrative of the fact, have been placed by him in the museum of St. Bartholomew's Hospital. (*On Ruptures*, p. 209. 211. ed. 4.) According to Langenbeck, this is the usual state of the parts. (*Comment.* § 105. tab. 17, 18, & 19.) Examined by accurate dissection, the course of the direct inguinal hernia appears to Sir Astley Cooper to be as follows: —"The sac first appears between the fibres of the tendon of the transversalis, nearly an inch directly above the ring, generally protruding before it the fascia transversalis. It then passes under the lower edge of the tendon of the internal oblique muscle. The epigastric artery runs upon the outer side of the hernial sac. The spermatic cord has no connection with it above the ring. The hernia then emerges from the abdominal ring, the spermatic cord being on its outer side, and it is covered with the fascia given off by the tendon of the external oblique, but *not by the cremaster muscle*." (*On Abdominal Hernia*, part i. p. 67. ed. 2.) There is some diversity in the descriptions given of the coverings of the direct inguinal hernia. In the dissection of a double scrotal hernia by Mr. Todd, where both protrusions were of the direct kind, "the cremaster muscle, on one side, was distinctly spread out on the fore part of the sac; while, on the other side, the character of the muscle was completely lost." (See *Dublin Hospital Reports*, vol. i. p. 231.) In a case described by M. Jules Cloquet, the coverings were besides the integuments and superficial fascia, 1. the intercolumnar fascia; 2. fleshy and aponeurotic fibres of the internal oblique muscle; 3. a thin fibro-cellular covering derived from the margin of a lacerated opening, in the fascia transversalis, by which the hernia had escaped; 4. the hernial sac itself. (See *Jules Cloquet, Pathologie Chir.* p. 126. 4to.) In general, if the hernia is at all covered by the cremaster, it can only be just at its outer part, as represented in the plate in Sir Astley Cooper's great work. (See p. 70. part i. ed. by *Mr. C. Aston Key.*) There must necessarily be some variety in the number of coverings of this hernia, in different cases, according to the circumstance of its being attended, or not, with a laceration of the conjoined tendon of the internal oblique and transverse muscles. If weak, they may yield and form a covering. Sometimes, however, as already stated, the tendon of the transverse muscle is lacerated, and the hernia passes out, under that of the internal oblique. The fascia transversalis may be completely lacerated, or it may be dilated into another investment. We may say, then, that the direct hernia is at all events not much covered by the cremaster, but that it may have one covering which the oblique hernia has not; namely, that which is formed by a weak and dilated portion of the tendon of the transversalis muscle. In other respects, the coverings of the two herniæ are alike. The earlier dissections made by Hesselbach, led him to suppose, that the opening, through which the protrusion happens, is always annular, and the swelling in front of the ring globular; but subsequent cases, which he has met with, have informed him, that the opening is frequently sloping and longish; in which circumstance, the resemblance of the tumour to that of the external bubonocele with a shortened neck, is such, that the only mark of distinction between the two cases is the position of the spermatic cord. In females, even this criterion is of course deficient. (*Hesselbach*, p. 57.) Though individuals of almost every age are subject to internal bubonoceles, they are much less common, than external cases. According to Hesselbach, they may be known by the following characters: —1. The swelling, formed by the body of the hernial sac, immediately in front of the abdominal ring. 2. The situation of the spermatic cord. 3. That of the epigastric artery.

1. The neck of the hernial sac, besides being very short, does not, like that of an external inguinal hernia, take an oblique direction, but advances straight from behind forwards, through the abdominal ring; and, as the body of the sac lies directly over the neck, none of the swelling formed by the distension of the latter part can be felt; nor does any other tumour, produced by the body of a hernial sac, ever cause a circular spherical swelling directly before the abdominal ring. The situation of the neck of this kind of hernia must already apprise us, that the internal bubonocele is nearer than the external to the symphysis of the pubes; or, as Sir Astley Cooper states, the tumour below the abdominal ring is situated nearer the penis, than the swelling caused by an external or oblique inguinal hernia. (*On Abdominal Hernia*, part i. p. 67. ed. 2.) In women, the shape of the tumour is the only character, by which the case can be distinguished. (*Hesselbach*, p. 43.) Above the abdominal ring, as Sir Astley Cooper has explained, "the sac passes directly upwards, so that no part of it takes the usual oblique direction towards the anterior superior spinous process of the ilium, but rather the contrary direction towards the linea alba."

2. The spermatic cord passes on the outer side of the direct inguinal hernia, instead of behind it, as in oblique cases, particularly at and above the abdominal ring. (See *Sir A. Cooper*, *Op.* cit. part i. p. 67. ed. 2.) Hesselbach describes the cord as lying either upon the outer side, or outer half of the fore part of the upper portion of the hernial sac, the blood-vessels forwards, and the vas deferens backwards. When the sac is adherent to the whole length of the cord, the testis is not situated under the fundus of the sac, as in the oblique scrotal hernia, but either at the fore part or outer side of the body of the sac. The hernial sac, as far as the abdominal ring, is excluded from the common peritoneal covering of the spermatic cord; but, at this opening, it descends between the cord and the internal thin part of the sheath of the cremaster, which, however, is somewhat stronger towards the front and outer side of the hernia, over which part alone the fleshy fibres of the cremaster are spread. (*Hesselbach*, p. 44.)

3. The epigastric artery always ascends obliquely inwards at the outer side of the neck of the hernial sac. Hesselbach has never seen but one case of internal bubonocele, in which there was a deviation from this rule. The example has been already mentioned; and was one in which the epigastric artery arose from the obturatrix about an inch from the origin of this last vessel. The viscera, usually contained in an internal inguinal or scrotal hernia, on the right side, are the lower part of the small intestines, and sometimes omentum; on the left, a part of the small intestines, frequently omentum, and, when the tumour is large, the colon may also protrude. A protrusion of the bladder may accompany the disease, but that organ is of course always excluded from the cavity of the hernial sac. When the remains of the umbilical cord are situated more outward than usual, and lie over the centre of the space, at which the protrusion happens, an internal bubonocele may be double, the prolapsus happening on each side of that ligamentous substance, which is itself also pushed outwards. In consequence of the accidental presence of some very strong tendinous fibres at the centre of the fascia, called by Hesselbach the internal inguinal ligament, there may also be two distinct protrusions, with separate hernial sacs. (P. 46.)

When the surgeon, by a due consideration of the foregoing circumstances, has formed a judgment respecting the nature of the hernia, he will be better qualified to regulate the treatment of the case. Thus, in the external inguinal hernia, he will know that the pressure employed for the reduction of the bowels should be made in the direction of the neck of the hernial sac, viz. obliquely upwards and outwards, towards the anterior superior spinous process of the ilium; but, that when the neck of the same kind of hernia is very short, and the posterior side of the inguinal canal has been removed, the pressure should be made nearly in a straight line from before backwards. For what Hesselbach terms the long-necked external inguinal hernia, the pad of a truss should be so constructed as not merely to press upon the abdominal ring, but also upon the neck of the sac and the inner opening of the inguinal canal. But, when the neck of the hernia is very short, the pad should be nearly of the same form, as that required for an internal inguinal hernia. (*Hesselbach*, p. 38.; and *Brünninghausen*, *Gemeinnütziger Unterricht über die Brüches*, *&c.* Würzb. 1811.) For this last case, or the direct inguinal hernia, Sir Astley Cooper recommends the truss to be longer, than for an oblique bubonocele, because the hole, through which the sac emerges from the abdomen, is one inch and a half farther inwards towards the pubes. (*Op.* cit. part. i. p. 67.) In attempting the reduction of an internal inguinal hernia, the pressure should be directed nearly straight backwards; and the pad of the truss should only act upon the abdominal ring. (*Hesselbach*, p. 46.) The direction given by Sir Astley Cooper is, that the tumour should be grasped with one hand, " but the fingers of the other are to be placed at the abdominal ring to *knead* the hernia at that part, directing the pressure upwards and inwards, instead of upwards and outwards." (*Ib.*) It is a case in which the intestine often continues strangulated after the reduction within the ring. (*Sir A. Cooper; see Lancet*, vol. ii. p. 142.)

Operation for Strangulated Inguinal Hernia.

Sir Astley Cooper particularly recommends operations for strangulated herniæ to be performed before any peritoneal tenderness exists, which renders the issue very doubtful, though the parts be liberated by the division of the stricture. Such tenderness is not to be confounded with the tension produced by the inflation of the intestines. (*On Abdominal Hernia*, part i. p. 36. ed. 2.) " The herniæ of the very young and the very old require the operation less frequently than those of the middle period of life, when the fibres are firmer and the muscular strength more robust. In the tenderness of youth and the relaxation of age, the reduction of the hernia by the taxis is almost always practicable; and it is principally in old persons that much time elapses before the strangulation produces fatal effects; the period of their sufferings having been known to be protracted to twenty days. (*Sir A. Cooper, Op.* cit. part i. p. 37. ed. 2.)

The operation consists in dividing the integuments; dissecting down to the sac, and opening it, removing the stricture, and replacing the protruded viscera. The hair is first to be shaved from the pubes.

The external incision should begin an inch above the external angle of the ring, and extend over the middle of the tumour to its lower part; except when the swelling is large, in which circumstance, the cut need not extend so far down, as will be presently noticed. The advantage of beginning the wound so high is to obtain convenient room for the incision of the stricture. By this first cut the external pudic branch of the femoral artery may be divided: it crosses the hernial sac near the abdominal ring, and sometimes bleeds so freely as to require to be immediately tied. In general, however, a ligature is unnecessary.

When this incision is carried low down, the caution given by Camper should always be remembered, viz., that there is a possibility of dividing the spermatic vessels, should they happen to be situated, as they sometimes are, in front of the hernia. And, in order to avoid such an accident, which is particularly apt to occur in cases of internal inguinal or scrotal hernia, the incision through the skin should be made obliquely downwards and inwards. (*Hesselbach*, p. 46.) The division of the integuments brings into view the fascia, which is sent off from the tendon of the external oblique muscle, and covers the hernial sac.

The layers of tendinous fibres, cellular substance, &c. intervening between the skin and sac, should be carefully divided, one after another, with the knife and dissecting forceps; the edge of the former instrument being turned horizontally, lest the incisions be carried too deeply at once, and the viscera contained in the sac wounded.

After making a small opening through a part of the fascia covering the sac, some practitioners introduce a director, and divide this fascia upward and downward, as far as the tumour extends. The same manner they next pursue with regard to the cremaster muscle. Thus the sac becomes completely exposed. When this method is followed, Sir A. Cooper advises the incisions not to be carried upward nearer than one inch to the abdominal ring, for reasons which will be presently explained.

However, it may be rationally doubted whether there is any good in these formal and successive divisions of the whole length of the coverings of the sac, and it is certain that they protract the operation; for the manner in which the sac adheres to the outer investment of it, prevents the latter from being raised and cut without trouble and delay. As the grand object, after the skin has been divided, is to make a small opening into the sac sufficient for the introduction of a director, dissecting down at one particular place answers every purpose, and enables us, in the end, to lay open the whole of the sac and its coverings in the shortest time. Let the operator only take care to raise the successive layers of fibres with the forceps, and divide the apex of each elevated portion with the knife held horizontally. As there is commonly a quantity of fluid in the sac, and it gravitates to the lower part, to which the intestine seldom quite descends, this is certainly the safest situation for making the first opening into the sac. The operator, however, should not rely upon the presence of such fluid, and cut too boldly; for sometimes it is absent, and the viscera may be in immediate contact with, nay, adherent to, the inner surface of the sac.

The circular arrangement of the vessels of a piece of intestine, and its smooth polished surface, sufficiently distinguish it from the hernial sac, which has a rough cellular surface, and is always connected with the surrounding parts; although these adhesions, in a very recent case, may be but slight. (*Lawrence on Ruptures*, p. 232. ed. 4.)

I have mentioned, that Sir A. Cooper, only advises cutting the fascia, and other coverings of the sac, under the skin, to within an inch of the abdominal ring; and, of course, he also recommends limiting the division of the sac itself to the same extent. His reasons for this practice are, to avoid making the closure of the wound more difficult, and to lessen the danger of peritoneal inflammation.

Having laid open the hernial sac with a probe-pointed bistoury, guided by a director, or the forefinger, introduced into the opening, made at the lower part of the sac, the next desideratum is to divide the stricture, unless the viscera admit of being easily reduced without such an incision being made, as occasionally happens.

According to Sir Astley Cooper, the abdominal ring is the principal point of strangulation in old and large herniæ; and, in other cases, the stricture is more commonly seated at the internal ring, where the spermatic chord first quits the abdomen. " The strangulating pressure is here made by the internal oblique and tranversalis muscle and its tendon, which pass over the hernial sac in a semicircular direction, and by the fascia transversalis, arising from Poupart's ligament, the semicircular border of which passes under the sac." (See *Sir A. Cooper on Hernia*, part i. p. 29. ed. 2.)

Experience proves, I think, that the stricture may be situated either at the abdominal ring, and be formed by the margins of this opening, or at the upper opening of the inguinal canal, about one inch and a half, in a direction upward and outward, from the opening in the tendon of the external oblique muscle; or the strangulation may be caused by the semicircular edge of the transversalis muscle and its tendon, which pass over the neck of the hernial sac, and by the portion of the transverse fascia, arising from Poupart's ligament, the semicircular border of which passes, as Sir Astley Cooper represents, under this part of the sac.

Dupuytren calculated, that in at least eight out of every nine cases of strangulated bubonocele the stricture was seated at the neck of the hernial sac. (*Clin. Chir.* t. i. p. 558.) This observation also led him to believe, that such stricture was formed by the neck of the sac itself, in consequence of change in the structure and disposition of this part of the peritonæum. In a recent protrusion, however, it is manifest that the strangulation cannot depend upon any thickening of the neck of the sac. We shall presently find also, notwithstanding the statement of Dupuytren respecting the great frequency of strangulation by the neck of the hernial sac, that he takes into the account the pressure may be sharp margins of the inner ring. Hernia, constituting bulky external swellings, he found less subject to be strangulated in the neck of the sac, than cylindrical ones; but congenital herniæ the most liable of all to a stricture so situated. He remarks, that, whenever the stricture is at the neck of the sac, the whole, one half, a third, or a quarter, of the hernia, may be pushed towards the abdomen, whence it afterwards descends again; but that for these circumstances to happen, the tumour must be cylindrical, the inguinal canal wide, and the peritoneum not adherent. If, says Dupuytren, the stricture were at the abdominal ring, within the canal, or at its upper orifice, the tumour could not undergo such movement, because these parts are nearly unyielding, while the neck of the sac is quite otherwise, on account of the looseness of its connections. Dupuytren cautions surgeons not to be deceived by this apparent reduction; but, to use every possible means to make the parts descend again; and, if these will not answer, he advises dividing the ring, and drawing down the intestine. He had been called upon to adopt this practice in more than ten cases in the Hôtel Dieu. (*Clin. Chir.* t. i. p. 565.) Another observation made by this celebrated surgeon, is, that when the stricture is situated at the abdominal ring, the tumour, formed by the hernia, does not reach above this point. All the track of the inguinal canal is undistended, soft, and indolent to the touch, while the ring itself is closed, hard, and tense. On the other hand, when the stricture is at the neck of the hernial sac, that is, as high up as the superior orifice of the inguinal canal, this canal is always full, hard, and painful; and a cylindrical tumour can be felt, directed from below upwards, and from within outwards. So far is the ring from causing the constriction, that the finger may sometimes be insinuated between its margin and the protruded parts. In some patients Dupuytren found the strangulation existing all along the inguinal canal; a case, in which he recommends that canal to be laid open its whole length by dividing its upper border. He also notices the occasional existence of two strictures, a slight one at the abdominal ring, and a closer one at the neck of the sac. (*Op.* cit. p. 565.)

The recollection of the frequent situation of the stricture higher up than the abdominal ring, is of vast practical importance. I have seen several cases, where surgeons, imagining that the abdominal ring caused the strangulation, divided it, and then pushed the hernia seemingly into the abdomen, but in reality only into the inguinal canal. The bad symptoms of course went on, and the patients lost their lives. Dupuytren was present at an operation where the same things happened. We should therefore, be careful to ascertain the seat of stricture, by drawing the protruded bowel gently down, and introducing the finger within the sac.

It is observed by Dupuytren, that when the stricture is placed at the upper orifice of the inguinal canal, the parts sooner become gangrenous, because the edges of this opening are so sharp, that they make great pressure on the neck of the sac; while the abdominal ring, which is wider, and has blunter margins, causes a slower strangulation, and less pressure on the intestine. In the first case, the operation must in general be performed sooner than in the last. (*Dupuytren, Clin. Chir.* t. i. p. 566—569.)

When the mouth of the hernial sac becomes the seat of stricture, Sir Astley Cooper ascribes the circumstance to its inner part having been thickened by the pressure of the tendons of the internal oblique and transverse muscles; and "if a truss has occasioned much pressure on its outer side, the whole circle of the sac becomes thickened in consequence: thus, the cause of the stricture at the mouth of the sac is occasioned by parts external to the sac." (*Sir A. Cooper on Hernia*, p. 30. part i. ed. 2.)

The common, and probably the best, practice, is to divide the hernial sac, together with the stricture. When this is situated at the abdominal ring, the surgeon is to introduce the end of a director a little way into the neck of the sac, within the aperture in the tendon, and with a probe-pointed bistoury, guided on the latter instrument, *he is to cut the stricture upward and outward, or else directly upward;* a manner, which Sir A. Cooper recommends, because it is applicable to all cases, even the less frequent ones, in which the hernia protrudes at the inner side of the epigastric artery; and, in all common instances, we know that this vessel runs upward round the inner side of the neck of the sac; a course prohibiting the division of the stricture upward and inward.

In the external or oblique inguinal hernia, the method of cutting the stricture upward and outward is perfectly safe; but when the case is what Hesselbach calls internal, and the viscera descend on the inner side of the epigastric artery, it is a plan, which would endanger the latter vessel, and ought never to be adopted, notwithstanding any statement made in its favour by Rudtorffer. (*Abhandlung über die einfachste und sicherste Operations-Methode eingsperrter Leisten-und-Schenkelbrüche.* Wien. 1808.) As the epigastric artery ascends between the fascia transversalis, and the peritoneum, and not directly behind the tendon of the external oblique muscle, it is manifest, that the abdominal ring itself may be safely divided in any direction, so far as that vessel is concerned. It is with reference to the division of a stricture more deeply seated at or near the internal ring, that the direction of the cut is of the highest importance in relation to the epigastric artery. Sir A. Cooper's rule of always cutting in one direction, viz. upward, which I believe was first advised by Rougemont, and afterwards by Autenrieth. (*Dissert. Moment. circa Herniotom. præcipue circa evitandam Art. Epigastr. Læsionem.* Tub. 1799.) is an excellent one, because it is easy for the memory, and will answer very well, even when it is not in the power of the surgeon to pronounce positively, whether the case is a short-necked external bubonocele, or an internal one with an oblong oval fissure, cases having a great external resemblance, especially in women, in whom there is not the spermatic chord as a criterion; for, after all, this part, when present, is the surest guide, and that on which Desault founded his perfectly safe advice, viz., when the chord is at the posterior or inner side of the neck of the hernial sac, to divide the ring upwards and outwards, but inwards and upwards when it lay at the outer or on the fore part of the sac. (*Œuvres Chir. par Bichat*, t. ii.) At all events, this advice is subject but to one exception, which is the very rare one of the epigastric running round the inner side of the neck of the sac in an internal bubonocele; a possibility which has been already explained, and which leads Hesselbach particularly to recommend, with Sir Astley Cooper, the division of the ring, in every internal or direct inguinal hernia, to be made straight upwards. (P. 47.) Indeed, the long-necked external bubonocele is the only case, in which he thinks the latter plan should give way to that of cutting upwards and outwards. The safety and propriety of the method of always cutting upward, are strikingly illustrated by what Scarpa observes. He states, that the right direction of the incision of the ring is directly upwards, parallel to the linea alba. "I have (says he) operated in the way which I recommend, upon several dead subjects, who had either external, or internal inguinal hernia, directing my incision in the course of a line drawn from the upper part of the ring parallel to the linea alba: in all, I constantly left the epigastric artery untouched, even when I extended the cut about an inch above the inguinal ring." (*Scarpa, Traité Pratique des Hernies*, p. 111.) Only one objection, so far as I know, has been made to this plan, and it is founded on the alleged impossibility of introducing the knife, so as to cut straight upwards, when the neck of the hernial sac is long, because then the posterior side of the inguinal canal is in the way. (*Hesselbach*, p. 40.) No more of the parts, forming the stricture should be cut, than is just sufficient for allowing the protruded viscera to be reduced, without bruising, or otherwise hurting them; and, if the stricture be at the abdominal ring, I consider the middle of its upper column to be as good a point as any for the requisite incision.

Sir A. Cooper, in his valuable work on the Inguinal Hernia, advises a mode of dividing the stricture, considerably different from the usual method. He directs the finger of the operator to be introduced into the sac (which in his plan, we know, is left undivided for the space of one inch below the ring.) When the stricture is felt, a probe-pointed bistoury is to be conveyed over the front of the sac into the ring (between the two parts), and the latter only is then to be divided, in the direction upward, opposite the middle of the neck of the sac, and to an extent just sufficient to allow the protruded parts to be returned into the abdomen, without being hurt. The two chief advantages which Sir A. Cooper imputes to this method, are, that the danger of peritoneal inflammation will be less, and that the epigastric artery, if wounded, would not bleed into the abdomen. With regard to this proposal, it has been observed by Mr. Lawrence, "An accurate comparative trial of both methods would be necessary, in order to determine the weight of the first reason. The second circumstance cannot be a matter of any importance, if we cut in such a direction as will avoid the risk of wounding the artery. Many circumstances present themselves as objections to this proposal. The manœuvre itself, although perhaps easy to the experienced hand of so able an anatomist as Sir A. Cooper, would, I am convinced, be found highly difficult, if not impracticable, by the generality of surgeons. This difficulty arises from the firm manner, in which the sac and surrounding parts are connected, we might almost say, consolidated together. The experience of Richter (*Traité des Hernies*, p. 118.) shows, that this objection is founded in reality. He once tried to divide the ring, without cutting the sac, but he found it impracticable. If the stricture is so tight, as to prevent the introduction of the finger, there must be great danger of wounding the protruded parts. The practice would still be not advisable, even if it could be rendered as easy as the common method of operating. Sir Astley leaves an inch of the sac, below the ring, undivided: thus a bag remains ready to receive any future protrusion, and the chance of a radical cure is diminished." (See *Lawrence on Ruptures*, p. 249. ed. 4.)

Mr. Aston Key has proposed to revive the method of operating, adopted by Petit and the second Monro; viz., that of removing the stricture and replacing the protruded intestine, without dividing the sac. (See *Mem. on the Advantages, &c. of Dividing the Stricture in Strangulated Hernia, on the Outside of the Sac*, 8vo. Lond. 1833.) Mr. Key concludes from various cases, which he has recorded, that the principal cause of the fatality of operations for hernia, is exposure, or injury of the intestine, or both, and consequent peritoneal inflammation. "The exposure of a bowel in a state of incipient, or active inflammation, (says Mr. Key) the handling it in this susceptible state, the incision made into a peritoneal bag already disposed to, if not in an actual state of inflammation, are, as every surgeon will admit, (and as his forcible efforts to reduce the hernia without the knife prove that he feels them to be,) dangers of no ordinary magnitude to a patient labouring under a strangulated intestine. I do not feel that I have exaggerated the risk of inflammation; for, frequently, enteritis comes on, when at the time of the operation the bowel appears to be healthy, and the abdomen free from tenderness; and when general inflammation precedes the operation, the release of the intestine by the knife rarely succeeds in checking it." (P. 51.)

Mr. Key dwells likewise upon the great danger of roughly handling a hernia, particularly a large one, and of employing much force in repeated and long continued efforts at reduction by means of the taxis. He argues, that, as these proceedings cannot fail to bruise the protruded bowel, this part, like other contused tissues, must have a much better chance of recovery if its surface be not exposed. Mr. Key does not however, recommend the plan of not opening the sac in every example. For instance he acknowledges, that some forms of adhesion, either of the intestinal folds to one another, or to the sac, or to its neck, may render it necessary to open the sac more or less extensively. A case of adherent omentum does not, however, appear to Mr. Key a case, in which it is always requisite to open the sac. The first case, in which he tried the method, which he advocates, was an old irreducible umbilical hernia, in which a fold of intestine had recently protruded. On dividing the edge of the tendon, slight pressure caused the bowel to return into the abdomen. The object of removing diseased omentum with the knife, or ligature, does not appear to Mr. Key to be always a good ground for laying open the sac. Gangrene of the protruded intestine seems to him to be a case absolutely requiring that the sac should be opened. So also is the case of strangulation by the neck of the sac itself, though he deems such an occurrence rare.

The following is Mr. Key's description of his method in inguinal hernia: "The incision should begin at the neck of the tumour, or where it seems to quit the abdomen, and should be continued downwards for about an inch and a half. This will lay bare the lower portion of the external oblique tendon, where it forms the ring. A small opening should then be made in the tendon, just above the ring, sufficient to admit the end of the director, which will enable the operator to ascertain if the stricture be at the upper, or lower opening. The size of the hernia, and the length of time it has existed, will in some measure serve to guide him; but he may immediately decide the point by passing the director downward under the edge of the external ring, and feeling, whether it embraces the tumour firmly, or not, or by making pressure on the swelling below, he may feel if the fluid contents of the tumour can be forced upward above the ring, so as to distend the sac in the inguinal canal. This point being decided, if the stricture be at the lower ring, he has only to pass his director under its margin, and to divide it to a sufficient extent.

"If the stricture exists higher up, at the neck of the sac, where it will be found in the majority of herniæ of this description, the opening in the tendon should be enlarged to the extent shown in the second drawing, for the purpose of passing the director under the deeper stricture. The lower margin of the two muscles will be brought into view, with some of the descending fibres of the cremaster. These may be separated by disturbing the cellular membrane with the end of the director; and the instrument may then be introduced under the transversalis muscle till it reaches the stricture. The director, thus introduced, passes before the fascia transversalis, and all risk of wounding the peritoneum, or epigastric artery, is then obviated; but, when that fascia is very thin, it will perhaps often allow the director to pass beneath it.

"The instrument should be depressed upon the sac, in order to carry its point under the border of the transversalis, which may be divided to the extent required. This operation is more difficult, than the division of the stricture in femoral hernia. The principal difficulty lies in the accurate separation of the lower edge of the internal oblique muscle, for the easy passage of the director. The stricture, however, is not so firm in inguinal, as in femoral hernia, and the introduction of the director under the transversalis tendon will not be difficult, when it is fairly passed up to the neck of the sac, before the attempt is made. The steps of the operation will be much the same in those smaller herniæ, which are lodged in the inguinal canal." (*C. Aston Key, Op.* cit.)

Respecting this mode of operating, I may observe, that there can be no doubt of its being calculated to lessen the risk of the patient being destroyed by peritonitis; but I apprehend that the greater difficulty of accomplishing it, than the common operation, and the fact of some excellent anatomists having been baffled in their attempts to perform it on the living subject; will continue to prevent its general adoption. I have known the attempt made in one or two instances, and given up. However if a surgeon were confident, that he could execute the plan, (and Mr. Key's directions would greatly assist him,) I would not object to his doing so, if there were no circumstances in the case, likely to render the opening of the sac necessary. The method, I think, is not likely to be commonly followed.

If the stricture should be at the inner opening of the canal for the spermatic chord, Sir A. Cooper advises the operator to introduce his finger into the sac, as far as the stricture, and then to insinuate a probe-pointed bistoury, with the flat part of its blade turned towards the finger, between the front of the sac and the abdominal ring, till it arrives under the stricture formed by the lower edge of the transversalis and obliquus internus. Then the edge of the instrument is to be turned forward and the stricture, cut in the direction upward. This plan of not cutting the neck of the sac, is liable to all the objections stated by Mr. Lawrence, in regard to the case, in which the strangulation takes place at the abdominal ring. Sir A. Cooper's bistoury is a very proper one for dividing the stricture, as it only has a cutting edge to a certain distance from the point. Perhaps, on the whole, we may infer, that it is both most easy and advantageous to divide the neck of the sac, together with the stricture, whether this be situated at the ring, or more inward. The method of cutting the stricture from without inwards, I consider objectionable, on the ground of the risk of wounding the bowels in this mode, being greater, than that of any accident from wounding the epigastric artery, when it arises in an unusual manner, and deviates from its regular course; a reflection which has made Dr. Hesselbach, junior, an advocate for the practice. (See *Sicherste Art des Bruchschnittes,* 4to. Bamberg. 1819.)

When the stricture is at the upper opening of the inguinal canal, the ring should not be cut, unless it prevent the operator from reaching the more deeply seated strangulation, as is often the case.

M. Dupuytren cuts the stricture upwards and forwards, using no director in this stage of the operation, because, as he says, the bistoury is apt to slip out of the groove, and wound the intestine. (See *Clin. Chir.* t. i. p. 600.)

Room being made for the reduction of the protruded parts into the abdomen, by the division of the stricture, they are to be immediately returned, if sound, and free from adhesions. This object is considerably facilitated by bending the thigh. The intestines are to be reduced before the omentum, but, when a portion of mesentery is protruded, it is to be returned before either of the preceding parts. The intestine should always be reduced, unless it be found in a state of actual mortification. It often appears so altered in colour, that an uninformed person would deem it improper to return it into the abdomen. However, if such alteration should not amount to a real mortification, experience justifies the reduction of the part. Sir A. Cooper has judiciously cautioned the operator not to mistake the dark chocolate-brown discolorations for a state of gangrene. With these the protruded part is frequently found affected; and, as they generally produce no permanent mischief, they ought to be carefully discriminated from the black-purple, or lead-coloured spots, which usually precede mortification. To determine whether a discoloured portion of intestine be positively mortified, some recommend pressing forward the blood contained in the veins; and if they fill again, it is looked upon as a proof that the bowel is still possessed of life.

In returning a piece of intestine into the abdomen, the surgeon should first introduce the part nearest the ring, into this aperture, and hold it there till another portion has succeeded it. This method is to be continued till the whole of the protruded bowel is reduced.

The employment of force or violence, in the endeavours to return the contents of a hernia in the operation, cannot be too severely reprobated; a method the more pernicious, because such parts are more or less in a state of inflammation.

It is always better to enlarge the stricture, than pinch and bruise the bowel in trying to get it through an opening which is too small. Distension of the intestine sometimes prevents the reduction; but, when this is the only impediment, the part may generally be returned, as soon as its contents have been compressed into the intestinal canal within the stricture. It is better, however, to dilate the strangulation a little more, than use any force in trying to get the intestine back into the abdomen in the manner just suggested.

Reduction is sometimes impeded by the protruded parts adhering to each other, or to the hernial sac. The intestines are not often very firmly adherent together. The omentum and inside of the sac are the parts, which are most subject to become intimately connected by adhesions. The fingers will, commonly, serve for breaking any recent slight adhesions which may have taken place between the intestines and inside of the hernial sac.

When those adhesions are firm, and of long standing they must be cautiously divided with the knife; an object which can be most easily and safely accomplished, in case they are long enough to permit the intestine to be elevated a little way from the surface of the sac. But, provided their firmness and shortness keep the external coat of the bowel and inner surface of the sac in close contact, the greatest care is requisite in separating the parts with a knife, so as to avoid wounding the intestine. In doing this, the most prudent and safe method, is not to cut too near the bowel, but rather to remove the adherent parts of the sac, and return them with the intestine into the abdomen. Every preternatural connection should always be separated before the viscera are reduced: Sir A. Cooper mentions, that a fatal obstruction to the passage of the intestinal matter has arisen from the mere adhesion of the two sides of a fold of intestine together. (P. 31.) When the adhesions which prevent reduction are situated about the neck of the sac, and out of the operator's view, it is best to make the wound through the skin and abdominal ring somewhat larger, so as to be able to separate the adhesions with more safety.

Having reduced the parts, the operator should introduce his finger for the purpose of being sure that they are fairly and freely returned into the abdomen, and no longer suffer constriction, either from the inner opening, from the ring, or the parts just within the cavity of the peritoneum.

In strangulated enteroceles the peritoneal coat of the bowel is capable of bearing the pressure, longer than the mucous, which is soon circularly divided by it. But, if the strangulation has lasted two, or three days, the cellular tissue is cut through; and, in some instances, even the peritoneal coat itself. In operating upon such cases, the bowel should not be drawn out at all, before a free division of the stricture has been made, because it would occasion a risk of tearing one portion of the intestine from the other, and producing an extravasation in the abdomen. (See *Dupuytren, Clin. Chir.* t. i. p. 569.)

Sometimes a strangulated hernia is complicated with a hydrocele; a circumstance which may render it necessary either to cut through the latter swelling, or to limit the incision into the hernial sac, according as the hydrocele happens to cover the whole of the front of the sac, as seen by M. Cloquet and Mr. Stanley, or merely to advance in front of the lower part of the rupture. (*Lawrence on Ruptures*, p. 276. ed. 4.) See Hydrocele.

Treatment of the Omentum.

In an entero-epiplocele, this part, if healthy and free from gangrene, is to be reduced after the intestine. When, however, it is much diseased, thickened, and indurated, as it frequently is found to be, after remaining any considerable time in a hernial sac, the morbid part should be cut off. Its reduction in this circumstance would be highly improper, both because an immoderate enlargement of the wound would be necessary, in order to be able to put the diseased mass back into the abdomen, and because, when reduced, it would, in all probability, excite inflammation of the surrounding parts, and bring on dangerous symptoms. (See *Hey*, p. 172.)

The diseased omentum should always be cut off with a knife; and if any of its arteries should bleed, they ought to be taken up with a tenaculum, and tied separately with a small ligature. An unreasonable apprehension of hemorrhage from the cut end of the omentum has led many operators to put a ligature all round this part, just above the diseased portion which they were about to remove. This practice cannot be reprobated in terms too severe; for a frequent effect of it is to bring on a fatal inflammation, and even mortification of the omentum, extending within the abdomen, as high as the stomach and transverse arch of the colon. Sir Astley Cooper has remarked with great truth, that it is surprising this custom should ever have prevailed. The very object of the operation is to extricate the omentum from its strangulated state, arising from the pressure of the surrounding tendon; and no sooner has this been done than the surgeon includes it in a ligature, which produces a more perfect constriction, than that which existed before the operation was undertaken.

"When the omentum has suffered strangulation for a few days, says Mr. Lawrence, it often becomes of a dark red or livid colour; and there is an appearance, on cutting it, as if some blood were extravasated in its substance. This, I believe, is the state, which surgeons have generally described under the term of gangrene." (P. 262.)

When cut in this state, it does not bleed. I need hardly observe, that the dead part must be amputated, and never reduced. Some have advised leaving the omentum in the wound, especially in cases of old herniæ, in which it has been a long while protruded. Hey mentions cases, showing that granulations form very well, and that the wound becomes firmly healed when this plan is followed. (P. 180, &c.) Every one, however, will acknowledge the truth of what Mr. Lawrence says on this subject. The method "is attended with no particular advantage, but certainly exposes the patient to the possibility of ill consequences. The omentum, left in the wound, must be liable to injury, inflammation, or disease. Unnatural adhesions, formed by this part, have greatly impaired the functions of the stomach. Cases are recorded, where the unfortunate patient has never been able to take more than a certain quantity of food without bringing on instant vomiting; and even where it has been necessary for all the meals to be taken in the recumbent position, with the trunk curved and the thighs bent. (*Gunz.*) To avoid the possibility of such afflicting consequences, we should, after removing any diseased portion, carefully replace the sound part of the omentum in the abdominal cavity." (*On Ruptures*, p. 291. ed. 4.)

M. Dupuytren objected to the plan of cutting away the omentum, on account of the tediousness of the process of taking up the arteries, some of which may not after all be tied, and then hemorrhage will take place. He also bears testimony to the danger of including the mass of omentum in a ligature. His practice consisted, therefore, in reducing the omentum, if possible, after largely dilating the stricture. He admits, however, that there will be a considerable chance of inflammation from the efforts made in the reduction; and that local and general bleeding, and other antiphlogistic measures, may be called for. (*Clin. Chir.* t. i. p. 597.) The prudence of reducing a large mass of diseased or hypertrophied omentum I must continue to doubt, notwithstanding the authority of Dupuytren. I have seen it done, but almost always with an unfavourable result.

TREATMENT WHEN THE INTESTINE IN THE SAC IS MORTIFIED.

Sometimes, on opening the hernial sac, the intestine is found to be in a gangrenous state, although the occurrence could not be previously known, owing to the integuments and the hernial sac itself not being affected with the same mischief. In ordinary cases, however, both the skin and sac become gangrenous at the same time with the contents of the hernia. The tumour, which was previously tense and elastic, becomes soft, doughy, emphysematous, and of a purple colour. Sometimes the parts also now spontaneously return; but the patient generally survives only a few hours.

Sir A. Cooper has accurately remarked, that in other instances, the skin, covering the swelling, sloughs to a considerable extent, the intestine gives way, and, as the feces find vent at the wound, the symptoms of strangulation soon subside. When the patient continues to live in these circumstances, the living part of the intestine becomes adherent to the hernial sac, the sloughs separate and come away, and thus an artificial anus is established, through which the feces are sometimes discharged during the remainder of life. (See ANUS, ARTIFICIAL.)

Frequently, however, things take a more prosperous course; the feces gradually resume their former route to the rectum, and, in proportion as the artificial anus becomes unnecessary, it is shut up. Many instances of this sort have fallen under my own observation. (See ANUS, ARTIFICIAL.) The chance of a favourable event is much greater in some kinds of herniæ than in others. When the strangulation only includes a part of the diameter of the gut, the feces are sometimes only partially discharged through the mortified opening. This quantity lessens as the wound heals, and the patient gets perfectly well. (*Louis, Mém. de l'Acad. de Chir.* t. iii.; *P. S. Palm, De Epiplo-enterocele crurali incarcerata sphacelata, cum deperditione notabili substantiæ intestini, sponte separati, feliciter curata alvo naturali restituta*, 4to. Tub. 1748.; *Haller, Disp. Chir.* t. iii.) A small gangrenous spot or two may end in the same manner. Mortification, as well as wounds, of the large intestines, is much more frequently followed by a recovery than the same affection and similar injuries of the small intestines. Mortification of the cœcum and its appendix, in a hernial sac, has happened several times without materially disturbing the usual course of the feces to the anus, and the patients have soon recovered. (*Med. Obs. and Inq.* vol. iii. p. 162.; *Hey's Pract. Obs.* p. 162, &c.)

The grand thing, on which the establishment of the continuous state of the intestinal canal depends, in all these cases, is the adhesion which the living portion of the bowel, adjoining the mortified part, contracts with the peritoneum all round. In this manner, the escape of the contents of the bowels into the cavity of the peritoneum becomes in general completely prevented. The two ends of the sound portion of intestine, after the mortified part has separated, open into a membranous cavity, which previously constituted a portion of the peritoneal sac, and now unites the extremities of the gut. The gradual contraction of the wound closes the membranous cavity externally, and thus the continuity of the canal is restored. The two ends, however, are not joined so as to form a continued cylindrical tube, like that of the natural gut; but they are united at an angle more or less acute and the matter, which goes from one to the other, describes a half circle in a newly formed membranous cavity that completes the canal; a subject which has been more fully explained in another part of this work. (See ANUS, ARTIFICIAL.)

It is an observation of Sir A. Cooper, that the degree of danger, attending an artificial anus, depends on the vicinity of the sphacelated part of the intestinal canal to the stomach. Thus, if the opening be in the jejunum, there is such a small extent of surface for absorption between it and the stomach that the patient dies of inanition.

Let us now suppose, that the mortified state of the intestine has only been discovered after laying open the hernial sac in the operation. The mischief may only consist of one or more spots, or of the whole diameter of the protruded bowel. In the first case, the proper practice is to divide the stricture, and return the intestine into the abdomen, with the mortified spots towards the wound. Mild purgatives and clysters are then to be exhibited. The most favourable mode, in which a case of this kind ends, is when the intestinal matter gradually resumes its natural course, after being either partly or entirely discharged from the wound. But sometimes the patient sinks under the disease, or an artificial anus continues for life.

The repeated observations of modern surgeons have now decided that no ligature, passed through the mesentery, to keep the gangrenous part of the bowel near the wound, is at all necessary. The parts in the neighbourhood of the ring have all become adherent together, in consequence of inflammation, at the same time that the parts in the hernial sac mortified; and, of course, the partially gangrenous bowel, when reduced, is mechanically hindered by these adhesions, from slipping far from the wound. Desault and De la Faye both confirm the fact that the intestine never recedes far from the ring; and, even were it to do so, the adhesions which it soon contracts to the adjacent surfaces would, as Petit has explained, completely circumscribe any matter which might be effused, and hinder it from being extravasated among the convolutions of the viscera. (*Mém. de l'Acad. de Chir.* t. i. ii.)

When the chief part, or the whole, of the diameter of the protruded bowel is mortified, the first and most urgent indication is to relieve the bad symptoms arising from the distension of the intestinal canal above the stricture. "Let a free incision, says Mr. Lawrence, be made through the mortified part of the gut, in order to procure that evacuation of the loaded canal which nature attempts by the process of gangrene." If the intestine has already given way, a free division of the integuments and sac allows the exit of the accumulated matter; and the opening in the gut may be enlarged, if necessary. (*On Ruptures*, p. 299. ed. 4.) By such treatment, Sir Astley Cooper rescued from the grave a female, who was pregnant at the time of the operation, and was some months afterwards safely brought to bed. (*On Abdominal Hernia*, part i. p. 49. ed. 2.)

Here the division of the stricture is unnecessary, since all the mischief which the bowel can receive from it is done. This subject is well explained by Mr. Travers. (See *Inq. into the Process of Nature in repairing Injuries of the Intestines, &c.* p. 300, &c.) Mild purgatives and clysters will be proper to unload the bowels, and determine the course of the feces towards the anus. Should, however, the stricture appear, after the mortification, to impede the free escape of the intestinal contents, a moderate dilatation of it must undoubtedly be proper.

Mr. Lawrence has clearly exposed the impropriety of sewing the ends of the intestinal canal together, introducing one within the other, supported by a cylinder of isinglass, &c. put into their cavity, in those cases in which the whole circle of the intestine has mortified and been cut away, as was advised by former writers. By drawing the intestine out of the cavity, in order to remove the dead part, the adhesions behind the ring, on which the prospect of a cure chiefly depends, must be entirely destroyed; and new irritation and inflammation must be unavoidably produced, by handling and sewing an inflamed part. The adhesions would even be likely to render the scheme impracticable, as happened in a case related in the *Journ. de M. Le Roux*, t. xxi. p. 260. (*On Ruptures*, p. 314. ed. 4.)

Instead of such practice, Mr. Lawrence judiciously recommends dilating the stricture, and leaving the subsequent progress of the cure entirely to nature. The sloughs will be cast off, and the ends of the gut are retained by the adhesive process in a state of apposition to each other, the most favourable for their union. Thus, there is a chance of the continuity of the intestinal canal becoming established again.

Whatever experiments it may be allowable to make in wounds with protrusion and division of the bowels, nothing, I think, is now more completely established, than the absurdity and danger of attempting to stitch the bowels in cases of hernia.

Operation for large Inguinal Herniæ.

When the tumour is of long standing, exceedingly large, perhaps extending half way down to the knees, and its contents have never admitted of being completely reduced, the indication is to divide the stricture, provided a strangulation take place; but without laying open the hernial sac, or attempting to reduce the part.

The reasons against the common plan of operating, under such circumstances, are, the difficulty of separating all the old adhesions, the hazardous inflammation which would be excited by laying open so vast a tumour, and the probability that parts, so long protruded, might even bring on serious complaints, if reduced. J. L. Petit, and, afterwards, Dr. Monro, advised the sac not to be opened. (See *Mal. Chir.* t. ii. p. 372.; *Description of Bursæ Mucosæ*, 1788.) Mr. Lawrence recommends an incision of two or three inches in length to be made through the integuments over the abdominal ring. The fascia covering the hernial sac is then to be exposed by dissection, and an opening made in it. This will permit a grooved director to be put under the tendon; and the probe-pointed bistoury may be conducted, by means of the groove, to the part that requires division. If great difficulty should be experienced in accomplishing our object in this manner, a small aperture may be made in the sac near the ring, when the tendon may be divided with ease. The parts, after being thus liberated, should be returned into the belly by pressure on the swelling, if adhesions do not prevent it: at all events, they generally admit of being replaced in part. (*Lawrence on Ruptures*, p. 269. ed. 4.) A very interesting case has been recorded, in which the foregoing advice was deviated from, and a large scrotal hernia laid open; when it was found that nearly a foot of the colon was contained in the swelling, and could not be reduced. The integuments could not cover it; yet its surface granulated, the skin extended itself as the cicatrix contracted, over the swelling, which also diminished, and, in about six weeks, the cure was completed. (See *Journ. of Foreign Med.* No. xv. p. 460.)

Operation when the Hernia is so small that it does not protrude externally through the Ring.

In this kind of case, there is little appearance of external tumour; consequently the disease is likely to be overlooked by the patient and surgeon, and some other cause assigned for the series of symptoms. The manner of operating, in this form of the disease, differs from that in the common scrotal hernia: the incision is to be made in the direction of the spermatic cord, and the stricture will be found at the internal ring. (*A. Cooper on Inguinal Hernia.*)

Treatment after the Operation.

Evacuations from the bowels should be immediately promoted by means of clysters, oleum ricini, or small doses of sulphate of magnesia, dissolved in peppermint water; but the patient should not be allowed to quit the recumbent position, or get on the night-stool, as doing so is apt to bring on a protrusion of the bowels again. (See case in *Lancet*, vol. ii. p. 148.) The safest plan is to let something be put under him for the reception of the feces. In the course of another day, if costiveness follow the effects of the first medicines, and tenderness and tension of the belly come on, local and general bleeding, with the exhibition of liberal doses of calomel joined with opium, are strongly indicated. For some time the diet is to be low. When symptoms of inflammation of the bowels and peritoneum threaten the patient, general bleeding, leeches on the abdomen, fomentations, blisters, doses of the oleum ricini, and clysters, are the means deserving of most dependence, and should be resorted to, without the least delay. In these circumstances, the warm bath, sometimes recommended, I think is more likely to do harm than good, by the disturbance to which it subjects the patient. When all danger of peritoneal inflammation is past, and the patient is very low and weak, bark, wine, cordials, and a generous diet, must be directed. The effervescing saline draught with opium is the best medicine for quieting the disturbance of the stomach after the operation. Opium and cordials are the most eligible for checking diarrhœa. As the operation does not usually prevent the parts from becoming protruded again, a truss must be applied before the patient leaves his bed, and afterwards constantly worn.

Operation for Strangulated direct Inguinal Hernia.

Sir Astley Cooper directs an incision to be made through the integuments, along the middle of the tumour, from its upper to its lower part, following the longitudinal direction of the swelling, so that, if it has any inclination inwards towards the umbilicus, the incision is to incline in the same way. The fascia being thus exposed is to be divided, over the surface of the tumour, from the abdominal ring down to its lower extremity. The hernial sac is then to be cautiously opened from an inch below the ring. The finger is then passed into the sac, and the stricture felt for. If it is at the abdominal ring, Sir Astley Cooper introduces a blunt-pointed bistoury between the sac and the ring, and cuts the latter directly upwards. If the stricture is above the ring, he follows it with the knife, still in the same direction and anterior to it, opposite the middle of the mouth of the sac, till the dilatation is sufficient to allow his finger to slip into the cavity of the abdomen. Then the protruded parts, if in a fit state for reduction, are to be returned. "The parts (he observes) anterior to the sac, above the ring, and divided by the knife, are the tendons of the transversalis and internal oblique." (See *Sir A. Cooper, Op.* cit. part i. p. 68. ed. 2.)

Mr. C. H. Todd had an opportunity of dissecting an exceedingly uncommon variety of direct inguinal hernia, where the parts, "instead of passing anterior to the chord, protruded between the chord and the inferior pillar of the ring; so that the chord formed a sort of arch, embracing the neck of the sac for nearly two thirds of its circumference, close to the external abdominal opening." (See *Dublin Hospital Reports*, vol. i. p. 231.) Hence, in operating on inguinal hernia, Mr. Todd always makes it a rule, after exposing the superficial fascia, and before dividing the parts contiguous to the neck of the sac, "to feel and minutely examine those parts (particularly if they appear unusually bulky," and to satisfy himself as to the situation of the spermatic chord. "Having done this (says he), I proceed with confidence to expose the superior pillar of the ring, which ought, in every instance, to be completely denuded before a bistoury is introduced to cut the stricture." (*Ib.*)

Proposals for the radical Cure of the Bubonocele.

Of castrating the patient, applying caustic, or of the operation of the punctum aureum with this view, I need only say that they are barbarous, and not at all calculated for the attainment of the desired end. A description of these methods may be found in Paré, Wiseman, &c.

The old operation, termed the *royal stitch*, was one of the most promising plans. It consisted in putting a ligature under the neck of the hernial sac, close to the abdominal ring, and then tying that part of the sac, so as to render it impervious by the adhesive inflammation thus excited. The royal stitch, performed in this manner, has been actually attended with success. (*Heister*, vol. ii.) The umbilical rupture was cured by Saviard on similar principles; and Desault radically cured nine cases of exomphalos in children by tying the hernial sac.

Schmucker cured two irreducible ruptures, free from strangulation, by cutting away the body of the sac, after tying its neck. (*Chir. Wahrnehmungen*, b. ii.) In one case, Sir A. Cooper found cutting away the sac alone insufficient.

Petit, Sharp, Acrel, &c., record cases, which prove the danger and general inefficacy of the royal stitch.

Richter recommends scarifying the neck of the sac, with the view of producing an adhesion of its sides to each other; a plan which, he says, he found successful.

From the account, however, which has been given of the anatomy of the bubonocele, it is obvious that none of these methods can do more, than obliterate the sac as high as the ring, and never that portion of it which is within the inguinal canal. Hence the neck of the sac must still remain open for the descent of the viscera. This consideration, and that of the chances of bad and fatal symptoms from any operation undertaken solely for this purpose, and not urgently required for the relief of strangulation, are the grounds on which these experiments are now disapproved.

In 1829, M. Belmas suggested the scheme of introducing into the upper part of the hernial sac a little bladder or pouch, made of goldbeater's skin, and filled with air. The plastic matter (fibrine), which is soon effused, penetrates the material of which the little bladder is composed, and becomes, in some measure, combined with it. *The whole is alleged to acquire organisation*, and to contract adhesions to the ring and neck of the sac, so as to constitute a barrier against the descent of the viscera. The plan is asserted to have succeeded both on man and animals. The particulars, which are curious, are given by M. Velpeau. (See *Nouv. Elém. de Méd. Opér.* t. ii. p. 306.)

Mr. Jameson, of Baltimore, even ventured, at the urgent solicitation of a lady, whose hernia (a femoral one) had returned after having been strangulated and operated upon, to try to accomplish a radical cure on Taliacotian principles. In fact, he is stated to have formed a flap of the shape of a lancet, out of the integuments, with its broad end towards the former wound. After having been carefully raised, and twisted into the suitable direction, it was introduced into the sac within the crural canal. Here it was secured by closing the wound with sutures, and applying a bandage. This venturesome proceeding is alleged to have been completely successful. The experiment has not yet, I believe, been tried in any other case; and doubts may be entertained whether it deserves it, unless the patient were determined voluntarily to place his life in serious danger, instead of being content with the relief afforded by a truss.

One of the most recent proposals for the radical cure of hernia, is the employment of firm wooden blocks, in the place of a soft pad with the truss. A favourable report upon the subject has been drawn up by Dr. Reynell Coates and other American surgeons.

Crural or Femoral Hernia.

Verheyen, who wrote in 1710, first distinctly pointed out the nature of crural hernia, which, until then, had been generally confounded with bubonocele.

The parts composing this kind of hernia always protrude under Poupart's ligament, and the swelling is situated towards the inner part of the bend of the thigh. The rupture descends on the internal side of the femoral artery and vein, between these vessels and the os pubis, through the *crural ring* or *canal* for the transmission of the same vessels. And, as Hesselbach has remarked, the inner opening of this ring or canal is the predisposing cause of the disease; the peritoneum, spread over it, being gradually propelled into it by various occasional causes, so as to complete the tendency to hernia. The actual protrusion of the bowels may be formed either suddenly, or by degrees. As soon as the bowels have once passed the outer aperture, or what Cloquet terms more properly the lower opening of the crural canal, the hernia has more room for extending itself forwards, and to each side, and the integuments now become elevated into *an oval swelling, the long diameter of which is nearly transverse.* (*Hesselbach*, p. 47.) Gimbernat names the passage, through which the femoral hernia protrudes from the abdomen, the *crural*, Hey the *femoral ring*, and Cloquet the *crural canal.*

Females are particularly subject to this kind of rupture. It has been computed, that nineteen out of twenty married women, afflicted with hernia, have this kind; but that not one out of an hundred unmarried females, or out of the same number of men, have this form of the disease. (*Arnaud.*) I was lately consulted by the friends of a little girl, about eight years old, who has an unequivocal femoral hernia.

"The crural hernia," says Scarpa, "is frequently observed in women, who have had several children; it very seldom afflicts young girls, and still more rarely men. In the latter, the viscera can more easily escape through the inguinal ring, by following the spermatic cord, than they can descend along the the crural vessels, and raise the margin of the aponeurosis of the external oblique muscle, that forms the crural arch. In women, an opposite disposition prevails, in consequence of the smallness of the inguinal ring, which, in them, only gives passage to the round ligament of the uterus, and, besides, is situated lower down and nearer the pubes, than it is in men, whilst, on the contrary, the crural arch is more extensive, by reason of the wider form of the pelvis. Morgagni expressly says, that he never met with the crural hernia in the dead body of any male subject. *Mihi, ut verum fatear, nisi nondum in fœminis accidit ut eam viderem.* (*De Sed. et Caus. Morb.* epist. xxxiv. xv.) Camper gives us to understand almost the same thing. (*Icones Herniarum, in Præfat.*) Hévin often operated for this kind of hernia in females, but only once in the male subject. (*Pathol. et Therap.* p. 406.) Sandifort and Walter have both seen but a single instance of it in the dead body of the male subject. (*Obs. Anat. Pathol.* cap. iv. p. 72.; *Sylloge Comment. Anat.* p. 24. obs. 21.) Arnaud himself, to whom modern surgery is highly indebted for many important precepts on the operation for the strangulated crural hernia in both sexes, candidly confesses, that he had never had an opportunity of dissecting a hernia of this kind in the male subject." (*Scarpa, Traité des Hernies*, p. 201.)

Scarpa had at his disposal a male subject, in which there was a crural hernia, and he availed himself of the opportunity of examining the parts with the utmost care. He first injected the blood-vessels; he afterwards attentively dissected all the parts concerned in the disease; and he has published an exact description of the particulars, illustrated by an engraving.

According to Hesselbach, the femoral hernia, though not common in men, is more frequent than is generally believed, and often overlooked, on account of its being very small. (*Ueber den Ursprung, &c. der Leisten-und-Schenkelbrüche*, p. 47.) Thus, in an example published in a modern work, an inguinal and femoral hernia were met with together in a gentleman sixty-three years of age. On examination of the body after death, a small piece of intestine, forming a crural hernia, was found strangulated, and concealed under an inguinal rupture and a mass of fat. (*Sir C. Bell's Surgical Obs.* vol. i. p. 187.)

Mr. Lawrence states, that the femoral rupture is not so uncommon in men, as several authors would lead us to suppose. He has seen many instances of it. (*On Ruptures*, p. 409. note, ed. 4.) Dr. Breschet, it seems, has also seen as many as thirty examples of it in the practice of Dupuytren. (*Consid. et Obs. Anat. &c. sur la Hernie Fem.* in his *Concours*, p. 42.)

According to the observations of Scarpa, and all the best modern writers upon surgery, the crural hernia forms, both in the male and female subject, in the cellular substance, which accompanies the crural vessels below Poupart's ligament. The swelling follows the internal side of those vessels, and gradually descends into the fold of the thigh, between the sartorius, gracilis, and pectineus muscles. "Many surgeons believe (says Scarpa) that the hernial sac, and the intestines which it contains, are ordinarily situated above the crural vessels and the trunk of the vena saphena, and sometimes between these vessels and the anterior superior spine of the ilium. But, so far as my knowledge extends, this assertion is not supported by a single accurate description of the crural hernia in the early stage. It is true, that when the tumour has in time acquired a large size, and its fundus is inclined in a parallel manner to the fold of the thigh, it partly or entirely covers the crural vessels, and even the crural nerve, as Walter says he once observed. (*Sylloge Comment. Anat.* p. 24.) But it is not thence to be concluded, that the tumour in the beginning descended over the crural vessels, much less betwixt them and the anterior superior spinous process of the ilium. Neither must it be imagined, that the neck of the hernial sac becomes removed from the inner to the outer side of these vessels. If these two cases ever happen, they must be very rare; and the best authors, who have treated of crural hernia, concur in stating, that, in performng the operation, they have constantly found the viscera situated at the inner side of the crural vessels, but never at their outside. Even when the tumour, after acquiring a considerable size, is situated transversely over the crural vessels, the neck of the hernial sac has always been found upon their inner side, that is to say, between them and the pubes. Le Dran (*Observ. de Chir.* t. ii. p. 2.); La Faye (*Cours d'Opérations de Dionis*, p. 358.); Petit (*Œuvres Posthumes*, t. ii. p. 219.); Morgagni (*De Sed. et Caus. Morb.* epist. xxxiv. xv.); Arnaud (*Mém. de Chir.* tom. ii. p. 768.); Gunz (*De Herniis Libellus*, p. 78.); Bertrandi (*Trattato delle Operazioni*, t. i. *Annot.* p. 218.); Pott (*Chirurg. Works*, vol. ii. p. 152.); Desault (*Traité des Mal. Chirurg.* pp. 191—195.); B. Bell (*A System of Surgery*, vol. i. p. 387.); Richter (*Traité des Hernies*, chap. xxxiv.), Nessi (*Instituz. Chir.* t. ii. p. 198.); Lassus (*Méd. Opér.* t. i. p. 198.), and many other writers, all concur upon this point. "In support of their opinion (says Scarpa) I could cite a great number of cases of my own, which I have collected either in operating on several individuals for crural hernia, or in dissecting the same kind of hernia in the bodies of many female subjects, and in that of the man from whom I have taken the 8th plate. Lastly, also, having had an opportunity of dissecting, in a female, an enormous crural hernia, which descended one third of the way down the thigh, I observed, that the neck of the sac did not encroach at all upon the crural vessels, but lay entirely on their inner side." (*Scarpa, Traité des Hernies*, pp. 203. 206.) The tumour, on account of its situation, is liable to be mistaken for an enlarged inguinal gland; and many fatal events are recorded to have happened from the surgeon's ignorance of the existence of the disease. Mr. Lawrence once saw an hospital surgeon mistake a crural hernia for a glandular tumour, and the patient died, without any attempt being made to afford relief by the operation. (P. 413. ed. 4.) (See also Petit, *Mal. Chir.* t. ii. p. 293, &c.) A gland can only become enlarged by the gradual effects of inflammation; the swelling of a crural hernia comes on in a momentary and sudden manner, and, when strangulated, occasions the train of symptoms already described in our account of the inguinal hernia, which symptoms an enlarged gland could never occasion. Such circumstances seem to be sufficiently discriminative; though the feel of the two kinds of swelling is often not of itself enough to make the surgeon decided in his opinion. It is particularly remarked by Hesselbach, that, while a femoral hernia is incomplete, that is to say, within the outer opening of the passage, through which the parts descend, the disease presents itself as a round firm swelling, on the outer side of which the femoral artery can be felt pulsating: this small hernia may be mistaken for an inflamed gland, and the case can only be discriminated by the history of its origin and symptoms. (*Ueber den Ursprung der Leisten-und-Schenkelbrüche*, p. 51.) A femoral hernia may be mistaken for a bubonocele, when the expanded part of the swelling lies over Poupart's ligament. As the taxis and operation for the first case ought to be done differently from those for the latter, the error may lead to very bad consequences. *The femoral hernia, however, may always be discriminated, by the neck of the tumour having Poupart's ligament above it. In the bubonocele, the spine of the pubes is behind and below this part of the sac; but, in the femoral hernia, it is on the same horizontal level, and a little on the inside of it.* (See *Lawrence on Ruptures*, p. 414. ed. 4.)

In the male subject, "the crural hernia, in the early stage, says Scarpa, is situated so deeply in the bend of the thigh that it is difficult, even in the thinnest persons, to feel its neck; and, in examining its circumference with the extremity of the finger, the tendinous margin of the opening, through which the parts are protruded, can only be perceived with considerable difficulty. On the contrary, the inguinal hernia, however small it may be, is always less deeply situated: it is about half an inch above the bend of the thigh. In carrying the finger round its neck, the tendinous margin of the inguinal ring can be easily felt at its circumference; and, at the posterior part of the small tumour the chord, composed of the spermatic vessels, is distinguishable. *When the crural hernia has acquired a considerable size, its neck is always deeply situated in the bend of the thigh; but its body and fundus assume an oval form, and their great diameter is situated transversely in the bend of the thigh.* Whatever may be the size of the inguinal hernia, it always presents a tumour of a pyramidal form, the base or fundus of which, far from being directed towards the ilium, follows exactly the direction of the spermatic chord, and descends exactly into the scrotum. Besides the symptoms common to all hernial swellings, the crural hernia, when it has attained a certain size, presents some others, which are peculiar to it, such as *a sense of stupor and heaviness in the thigh*, and *œdema of the leg, and even of the foot*, of the same side." The reason, why œdema and numbness of the limb are particularly remarkable in cases of femoral hernia, is justly referred by Hesselbach to the circumstance of the femoral vessels and nerves, with numerous lymphatics, taking their course through the crural ring; and, according to his observations, the numbness and œdema are especially great, when the protrusion is omentum, which makes stronger pressure on the vessels and nerves than commonly happens in a case of enterocele. (P. 53.)

One case is recorded in which the pressure of an omental femoral hernia on the great vessels, had produced a varicose state of the vein, and a partial obliteration of the artery. (See *Jules Cloquet, Pathologie Chir.* p. 88.)

This kind of hernia is not disposed to attain so large a size as that which a bubonocele frequently exhibits. Yet, sometimes its magnitude is considerable, and its contents numerous. Thus, an instance was published by Professor Lallement, in which a femoral hernia, of forty years standing, contained the uterus, Fallopian tubes, the ovaries, a part of the vagina, and a considerable piece of the omentum. (See *Bulletins de la Faculté*, Janvier, 1816; and *Jules Cloquet*, in *Pathol. Chir.* p. 104.)

"In women, however, (as Scarpa observes) it is less easy to distinguish the crural hernia from the inguinal. In fact, the absence of the spermatic chord, and the nearer situation of the ring to the crural arch, may easily occasion a mistake. Sometimes, a woman may even be supposed to have a double crural hernia of the same side, whilst of these two distinct, though neighbouring herniæ, one may be inguinal, and the other crural. Arnaud (*Mem. de Chir.* t. ii. p. 605.) relates an instance of such a mistake." (*Scarpa, Traité des Hernies*, pp. 207, 208.)

This interesting writer takes occasion to observe further, upon this part of the subject, that the portion of the inferior pillar of the abdominal ring, which separates this opening from the internal and inferior angle of the crural arch, is so slender in women, that it is sometimes hard to distinguish the crural from the inguinal hernia, which is not the case in male patients.

Until a few years ago, the stricture, in cases of femoral hernia, was always supposed to be produced by Poupart's ligament. A change of opinion on this subject, however, has latterly taken place, in consequence of the observations made by Gimbernat in 1793. "In the crural hernia (says he), the aperture through which the parts issue, is *not* formed by two bands (as in the inguinal hernia), but it is a foramen almost round, proceeding from the internal margin of the crural arch (Poupart's ligament), near its insertion into the branch of the os pubis, between this bone and the iliac vein; so that, in this hernia, the branch of the os pubis is situated more internally than the intestine, and a little behind, the vein externally, and behind, and the internal border of the arch, before. Now it is this border which always forms the strangulation." (See *A New Method of operating for the Femoral Hernia.*)

The utility of knowing, that it is not Poupart's ligament which produces the strangulation, is insisted upon by Gimbernat as exceedingly important; for we then know; that cutting the lower and outer border of the external oblique muscle is quite erroneous. This proceeding is the more to be reprobated, because the lower pillar of the abdominal ring, in both sexes, will be divided by directing the incision upward, or upward and inward; and thus the abdominal and crural rings will be made into one common aperture, large enough to make the future occurrence of hernia very likely to happen. In the male, there is also considerable danger of the spermatic chord being cut. Cutting Poupart's ligament obliquely outwards is attended with still more danger; for the epigastric artery will infallibly be divided at its origin; and with all these hazards, the incision must be quite useless, unless carried on to the internal edge of the crural arch. (*Gimbernat*, p. 16.)

The inclination, however, of several modern writers to refer the strangulation entirely to Gimbernat's ligament is not sanctioned by the most careful observers, like Hesselbach and Langenbeck. (*Neue Bibl.* b. ii. p. 132.) The former justly remarks, that a complete femoral hernia may be strangulated in two places, either at the outer or inner opening of the passage, through which the protrusion happens. Nay, says he, that the strangulation is sometimes caused by the outer opening was known to former surgeons, for they remarked, that the constriction was removed by dividing the fascia. (P. 53.) And, in addition to these two modes of strangulation, is to be enumerated a third, in which the viscera are constricted by protruding through some weaker point, or accidental opening, in the anterior parietes of the crural canal (*Hesselbach*, p. 48.; *Cloquet, Recherches Anat.* p. 85.; also *Langenbeck, Op.* cit. p. 132.); or even through an aperture in the inner side of this passage, as we find depicted in the twentieth plate of Langenbeck's treatise "De Structurâ Peritonæi."

When the dissection is begun at the inside of the inguinal region, the following circumstances are noticed: after the removal of the peritoneum from the abdominal muscles, and from the psoas, iliacus internus, and the great vessels, the inner surface of the transversalis still has an investment, which Sir Astley Cooper first described, and named *fascia transversalis*, and which is always a white glistening aponeurosis. From the place, where the femoral artery lies under Poupart's ligament, to the anterior superior spine of the ilium, the preceding fascia is extended in a strong fibrous form behind the inner surface of Poupart's ligament, and a thin continuation of it is extended over the iliacus internus and psoas muscles, where it is called, by Sir A. Cooper and Cloquet, the *fascia iliaca*. The fascia of the transverse muscle closes the belly behind Poupart's ligament, as completely as the peritoneum does, so that between the femoral artery and the anterior superior spine of the ilium none of the bowels can protrude, which occurrence is still farther prevented by the fascia lata, which, below Poupart's ligament, is closely attached to the muscles of the thigh. By the pelvis being thus shut up, the origin of a crural hernia on the outside of the femoral vessels is rendered quite impossible. (See *Langenbeck, Neue Bibl.* b. ii. p. 112, &c.) This part of the explanation very nearly resembles that delivered by Sir A. Cooper, except that the latter describes the iliac fascia, and not what Cloquet calls the transverse fascia, as closing the pelvis from the spine of the ilium to the crural vessels. But this difference is easily accounted for, by the circumstance of Sir A. Cooper extending the name fascia iliaca beyond the limits given it by Cloquet and Langenbeck.

"From that part of the crural arch extending from the anterior superior spinous process of the ilium, to the outer edge of the external iliac artery (says Sir Astley Cooper) a strong fascia will be found to arise, extending upwards over the iliacus and psoas muscles. It may be traced inwards behind the femoral vessels, as far as the linea ileo-pectinea, being attached at that line to the ligament of the pubes, and to the tendon of the psoas parvus, when that muscle is present. This fascia has been particularly described by Gimbernat, and should be called fascia iliaca. If the fascia iliaca be carefully traced, it will be found to arise from the outer half of the crural arch, in conjunction with the outer portion of the fascia transversalis; the latter ascending before the peritoneum, while the former passes up behind that membrane; they unite at the outer side of the transversalis muscle, and appear as one continuous production. By the union of these two fasciæ at Poupart's ligament, and their separation to enclose the viscera, the contents of the abdomen are thus received into a blind funnel, and are prevented descending on the outer side of the iliac vessels. If the latter vessels be raised, the fascia iliaca will be seen descending behind them, as far down the thigh as the origin of the profunda, thus forming the posterior part of the sheath. Thus a sheath is formed, enveloping the femoral artery, vein, and absorbent vessels, anteriorly, by the descent of the fascia tranversalis, posteriorly by a similar process from the fascia iliaca; and by the union of these at the inner and back part of the sheath, the bag is rendered complete. At the upper part the sheath is broad, but, as it descends, it becomes more closely applied to the femoral vein and artery, giving it the appearance of a funnel. It is at the upper and inner part of this funnel, that the absorbent vessels enter the sheath, giving it, as has been already remarked, a cribriform appearance. This part of the sheath is much looser in its texture than the portion investing the artery and vein which is firm and unyielding on the fore part of the sheath, where the latter is united to Poupart's ligament.

"If the sheath be opened, the contents will be found separated by two membranous septa; one passing between the artery and vein, and a second, equally distinct, between the vein and the absorbents. The septum is formed by a process from the fascia tranversalis passing backwards to attach itself to the fascia iliaca." Sir Astley Cooper then proceeds to explain, that the artery and vein completely fill up the space in the sheath allotted to them; while the absorbents are loosely connected. (See *Sir A. Cooper on Hernia*, p. 10. part i. ed. 2.)

Near the anterior superior spinous process of the ilium, Langenbeck remarks, that the fascia of the transverse muscle has some strong fibres, which proceed inwards under the internal opening of the inguinal canal, of which they form, as it were, the bottom, and are named by Hesselbach, the *internal inguinal ligament*. They go over the femoral artery and vein, are connected above with the fascia of the transverse muscle, and below are continued into the fascia of the psoas and iliac muscles. Where these fibres pass over the femoral vessels, they expand into a firm aponeurosis, which, passing downwards, is intimately attached at the inner side of the femoral vein to the horizontal branch of the os pubis, close to the symphysis, and then joins the aponeurosis of the recti muscles. The expanded portion of the foregoing tendinous fibres, thus continued along the crista of the os pubis to the sheath of the rectus, forms the inner surface of *Gimbernat's*, or the *femoral* or *crural ligament*. The inner edge of this ligament is falciform and concave, the concavity being turned towards the femoral vein. Now where the fascia of the transverse muscle extends downwards, on the outer side of the crural artery, to the fascia of the psoas and iliac muscles, so as to close the pelvis between that vessel and the anterior superior spinous process of the ilium, it also forms, like Gimbernat's ligament, a falciform edge, the concavity of which lies close over the external convexity of the crural artery. Thus, partly by the concave edge of Gimbernat's ligament, directed towards the crural vein, and partly by the concave edge of the extension of the fascia of the transverse muscle to the fascia iliaca, which edge is turned towards the crural artery, an aperture is produced, through which the femoral vessels pass out of the pelvis. This opening is named by Cloquet the *upper opening of the crural canal*, or, as many English surgeons would say, of the *crural* or *femoral ring*. By Hesselbach, it is called the *internal opening for the femoral vessels*. However, as these vessels do not lie loosely and unconnectedly in this aperture, the opening itself is shut up, as it were, and cannot be seen without dissection.

On the above described fasciæ, there is a considerable quantity of cellular tissue which covers the vessels in the pelvis, forms a sort of sheath for the crural artery and vein, and accompanies these vessels through the inner opening of the crural canal, or ring, which is itself accurately shut up by it. When this cellular tissue is removed, the white glistening fasciæ are plainly seen passing through the same opening, and coming nearer together in a funnel-like manner. (See also *Sir A. Cooper on Hernia*, p. 10, part. i.) Where the fascia of the transverse muscle forms the outer falciform edge of this aperture, and is passing over the arteria circumflexa ilii to the psoas and iliac muscles, it sends off through the opening, a process which becomes connected with the outer side of the crural canal, or ring; while from the internal inguinal ligament which lies above this opening, and constitutes the upper edge of the inner aperture of the crural canal, a production is sent, which is connected with the anterior side of this canal. As for the posterior and inner sides, they have a connection with the fasciæ of the psoas and levator ani.

When the groin is externally dissected, in order to have a view of the crural ring or canal, on the outside of the pelvis, the following appearances present themselves:—after the removal of the common integuments, one finds below Poupart's ligament, a quantity of fat, glands, lymphatics, veins, and arteries, which vessels come out through small openings in the fascia lata. As soon as the outer surface of the external oblique muscle is cleared, its aponeurosis is found to become stronger at the anterior superior spinous process of the ilium, and its fibres to collect together, and assume the form of a band, which is Poupart's ligament, called by Hesselbach the *external inguinal ligament*, and by Gimbernat, Cloquet, and others, the *crural arch.* This ligament, as is well known, passes obliquely, inwards and downwards, towards the os pubis, and after forming the external pillar of the abdominal ring, is first closely inserted into the angle, or tubercle of the os pubis, and then being continued inwards, or backwards, in the form of a firm fascia, is attached to the horizontal ramus of that bone, making the *anterior or outer face of Gimbernat's, or the femoral, ligament,* which is consequently produced by the junction of Poupart's with Hesselbach's internal inguinal ligament along the spine of the os pubis. Thus, just as the internal inguinal ligament is a strengthened part of the fascia of the transverse muscle, the outer inguinal ligament, (or, as it is here commonly called, Poupart's ligament,) is produced by the strengthened fibres of the lower portion of the aponeurosis of the external oblique muscle, the fibres of it, making the external pillar of the ring, being continued further towards the symphysis of the pubes, in the form of the outer surface of Gimbernat's ligament. (*Langenbeck, Neue Bibl.* b. ii. pp. 120, 121.) Some English surgeons make the formation of Gimbernat's, or the femoral ligament more simple; thus, Mr. Lawrence states, that when Poupart's ligament approaches the pubes, "it becomes suddenly broader; that it is fixed by this broad portion, along the whole length of the angle and crista of the pubes; that it has a rounded and strong anterior edge, a thin and sharp posterior margin; and that the former of these is nearer to the surface, while the latter is comparatively deeply seated. The breadth of this part varies, in different subjects; it is generally from three quarters of an inch to an inch. Sometimes, as Gimbernat has stated, it measures more than an inch. Dr. Monro has observed, that it is broader in the male than in the female subject; and, from this structure, he explains in part the more rare occurrence of this rupture in the male." (P. 368. ed. 3.)

The fascia lata, which is spread over the muscles of the thigh, is only a continuation of the aponeurosis of the external oblique muscle, and, as it proceeds downwards from Poupart's ligament, is very closely attached to the muscles of the thigh, all the way from the anterior superior spinous process of the ilium to the femoral artery, drawing, as it were, Poupart's ligament downwards and inwards, or backwards, towards the cavity of the pelvis, so as to give to its external edge a convex appearance, and shut up the outside of the pelvis, from the anterior superior spine of the ilium as far as the crural nerve and artery, so firmly, that the formation of a femoral hernia at this part is impossible. And, if small apertures, filled with fat, be discernible in this portion of the fascia lata, still no hernia can here take place because, as Langenbeck has already explained, here the interior of the pelvis is again shut up by fasciæ already described.

Under the fascia lata are situated the anterior crural nerve, the vein, and artery. The vena saphena magna lies on the outside of it, and passes through an opening in it into the femoral vein. This aperture in the fascia lata is at the inner side of the groin, opposite the internal opening of the crural ring, or canal. It is named by Hesselbach *the external aperture for the femoral vessels,* and described by him as an oblique fissure about fifteen lines in length. He takes notice of its external semilunar edge, and two horns which are directed inwards; the parts first particularly described by Mr. A. Burns of Glasgow, under the name of the *semilunar* or *falciform process of the fascia lata.* The lower horn bends rather inwards and upwards, and terminates in the production of the fascia lata spread over the pectinalis muscle. The upper horn, which is less curved, buries itself under the external pillar of the abdominal ring. Over the lower horn of the opening, just now described, the vena saphena magna ascends into the femoral vein. Through the same aperture also pass nearly all the superficial lymphatics of the lower extremity. According to Cloquet, the fascia lata consists of two layers, of which the anterior superficial one is closely attached to the crural arch, extends over the femoral vessels, and forms the anterior side of the crural canal. The other layer near the pubes, quits the former, and, covering the pectinalis muscle, constitutes the hinder side of that canal. The anterior layer of the fascia then forms an oval aperture, through which the vena saphena passes, and which is considered by Cloquet as the *lower opening of the crural canal.* This opening called by Hesselbach the *external foramen for the femoral vessels,* is well delineated both in his excellent work, and in the twenty-third plate of Langenbeck's book. (*De Structurâ Peritonæi, Testiculorum Tunicis, &c.* 8vo. Gött. 1817.) According to the investigations of the last anatomist, as soon as the integuments are removed, this opening in the fascia lata, with its external semilunar edge and two horns are regularly seen. The front side of the crural canal is formed by the fascia lata, Where this fascia proceeds in the form of Hesselbach's upper horn under and behind the external pillar of the abdominal ring and makes the outer layer of Gimbernat's ligament, it is continued as a thin aponeurosis over the vena saphena, so that it makes not merely the upper horn, but reaches further downwards and forms the outer side of the crural canal. The outer side then of the crural canal, or ring, according to Langenbeck, extends from the outer semilunar edge of the external opening for the femoral vessels, or as English surgeons would say, from the edge of the *falciform process of the fascia lata.* The larger the preceding thin continuation of fascia is, the smaller is the external opening for the femoral vessels, the more is the upper horn bent downwards, and the more determinate is the form of the canal. (*Langenbeck, Neue Bibl.* b. ii. pp. 124, 125.)

According to Mr. Lawrence, "at the upper and anterior part of the limb, the fascia lata consists of two portions, an external and an internal, with distinct insertions. The former, which is the thickest and strongest, covers the sartorius and rectus femoris, and is inserted into Poupart's ligament, from the anterior superior spine of the ilium to the inner edge of the femoral vein. The latter thinner and weaker, covers the pectineus and abductor muscles, and is inserted into the pubes, in front of the origin of the former. It passes behind the femoral vessels, and is there continuous with the iliac fascia, while the external portion covers these vessels anteriorly, just below the crural arch, and the vessels themselves are consequently situated between these two divisions of the fascia." (*On Ruptures,* p. 391. ed. 4.)

Where the insertion of the fascia lata into Poupart's ligament ends, it forms what Mr. Burns of Glasgow calls the *falciform process*, the upper part of which is attached to the above ligament, while the lower proceeds farther down the thigh. The concavity of the falciform process is directed towards the pubes. This anatomical connection is one chief cause, why extending the thigh and rotating it outward, render the crural arch tense.

The hernia being situated in front of the pectineus, must of course be exterior to the pubic portion of the fascia lata. This part of the subject is rendered very clear in the works of Sir Astley Cooper, Lawrence, Hesselbach, Langenbeck, and Jones Quain. The variety of crural hernia, which descends farther than usual in the sheath of the femoral vessel, lies of course under the continuation of the iliac portion of the fascia lata.

Mr. Lawrence states, that "the upper end of the falciform process passes over the upper and outer part of the neck of the tumour; it is then folded under the crural arch, and continues into the thin posterior border. The iliac vein is placed on its outer side; the pubes is directly behind it; and the upper and inner parts are bounded by the thin posterior edge of Poupart's ligament. It is this part which forms the strangulation." (*On Ruptures*, p. 404. ed. 4.) While, however, the latter statement is made by this gentleman and others, Sir Astley Cooper as positively declares, that the stricture is never situated at Gimbernat's ligament, but at the crural arch, just where the viscera leave the abdomen. He also mentions, that he has known the stricture continue after the division of that ligament, and the patient die. The view taken of this part of the subject, by Hesselbach and Langenbeck, I have already explained.

The inner side of the crural ring or canal, as already explained, is connected with the fascia of the transverse muscle. And, according to Langenbeck, below the part of the fascia lata, which forms the external foramen for the femoral vessels, the front side of the crural canal is sometimes formed by a continuation of the fascia of the transverse muscle, as he found was the case in both groins of one female subject. In such a case, there is a good deal of fat between the fascia lata, and the aponeurosis of the transverse muscle, and the two parts are easily separable. Langenbeck admits, however, that the same appearance may arise from a splitting of the layers of the fascia lata. Frequently the front side of the crural ring is so short that the opening cannot rightly be termed a canal, and it is always shorter than the posterior side. When the outer side exists, it is extended across the inner over the space between the two horns, and is then connected with the aponeurosis of the pectinalis derived from the fascia of the psoas and levator ani muscles. In the anterior and inner sides of the crural canal, there are some small openings. Doubtless this structure is referred to by Hesselbach, when he says, that in the male subject the outer opening for the femoral vessels is farther closed by a net-like web of tendinous fasciculi. The posterior side of the crural canal, or ring, is entirely formed by the part of the fascia of the psoas, which enters its inner opening, and joins the aponeurosis of the pectinalis muscle. The outer side of the canal lies under the fascia lata, and joins the anterior and posterior sides, where the aponeuroses of the transverse and iliac muscles proceed to the outside femoral artery. Langenbeck thinks the opening, by which the vena saphena passes over the lower horn of the falciform process of the fascia lata, might be named the *lower aperture of the crural canal.* (See *Langenbeck's Neue Bibl. für die Chirurgie*, b. ii. pp. 126, 127. 8vo. Hanover, 1819.)

According to Hesselbach, in femoral hernia, the two openings of the passage now termed the crural or femoral ring, are one half larger than natural. The outer portion of the inner of these apertures is propelled more outward, and with it the epigastric artery. The femoral vein no longer lies at the external end of this opening, but rather at the back of the canal or passage. The external semilunar edge (the falciform process) of the outer opening is carried more outward and upward, and is tightly applied over the distended hernial sac. In this state of the parts the outer opening forms an oval firm tendinous ring, the direction of which, like that of the inner opening for the passage of the femoral vessels, is transverse. The neck of the hernial sac is that portion of it, which lies within the canal between the two openings. The posterior side of this canal, or passage, now frequently named the crural, or femoral ring, is longer than the anterior. In one large hernia, Hesselbach found it an inch and a half in length, but the anterior side of the passage more than one third shorter. The greatest diameter of the inner opening was one inch five lines, while that of the outer one was only one inch, four lines. Most of the posterior part of the neck of the hernial sac, with the hinder side of the canal, lies upon, the pectineus muscle, and towards the outer side upon the femoral vein. The neck of the hernial sac adheres more firmly to the anterior, than to the posterior side of the passage. At the outer opening of the passage, the neck terminates at almost a right angle forwards in the body of the sac, the upper portion of which lies upon Poupart's ligament, but the largest part of it is situated on the deep seated layer of the femoral fascia, by which the outer side of the body of the sac, as high as the neck, is separated from the crural vessels and nerves. In the male subject, when the tendinous fibres, mixed with the cellular substance covering the outer opening of the passage, make great resistance at particular points, the hernial sac of a femoral hernia may be double, or even divided into several pouches, a preparation exhibiting which occurrence is in the anatomical museum at Würzburg. (*Hesselbach*, p. 48.) Except in a few cases, in which the origin and course of the epigastric artery are unusual, this vessel runs very close to the external side of the neck of the hernial sac, much nearer than it does in an internal bubonocele.

The sac of the femoral hernia is exceedingly narrow at its neck; and, where its body begins, it becomes expanded in a globular form: the sac of the bubonocele is generally of an oblong pyramidal shape. The body of the sac of the femoral hernia, makes a right angle with the neck, by being thrown forward and upward, a circumstance very necessary to be known in trying to reduce the parts by the taxis. Though the tumour formed by the body of the sac is oval and nearly transverse, it is found when attentively examined, to take the direction of the groin, which extends obliquely downwards and inwards, the outer rather smaller end of the swelling being somewhat higher than the inner. (*Hesselbach*, p. 50.)

The sac of the femoral hernia is said by Sir A.

Cooper to be covered by a kind of membranous expansion, consisting of condensed cellular substance, and named by him the *fascia propria*, which is thus described :—“ A thin fascia naturally covers the opening, through which the hernia passes, and descends on the posterior part of the pubes. When the hernia, therefore, enters the sheath, it pushes this fascia before it, so that the sac may be perfectly drawn from its inner side, and the fascia which covers it, left distinct. The fascia which forms the crural sheath, and in which are placed the hole or holes for the absorbent vessels, is also protruded forwards, and is united with the other, so that the two become thus consolidated into one. If a large hernia is examined, the fascia is only found to proceed upwards, as far as the edge of the orifice on the inner side of the crural sheath, by which the hernia descends; but, in a small hernia it passes into the abdomen, as far as the peritoneum, and forms a pouch, from which the hernial sac may be withdrawn, leaving this, forming a complete bag over the hernia.” (*On Hernia*, part 2. p. 6.)

The thin fascia, described by Sir Astley Cooper, as shutting up the crural canal, and protruded by the viscera, is the septum crurale of M. Cloquet; who observes, that it resists the finger, when we endeavour to pass it from above downwards beneath the crural arch. It is always perforated by small apertures for the passage of lymphatics. One of these apertures, more considerable than the rest, is central, and sometimes occupied by an elongated absorbent gland. The sac of femoral hernia sometimes pushes before it the septum crurale; and, in other instances, protrudes through one of its apertures, which may then become a cause of stricture. (See *J. Cloquet, On Hernia*, p. 40. tr. by *McWhinnie.*)

By Sir Astley Cooper, M. Cloquet, and the generality of modern surgeons, the femoral hernia is described as protruding into the sheath of the femoral vessels. The correctness of this description, however, Mr. Guthrie does not admit; but only because he will not consider the passage for the lymphatics, on the pubic side of the septum, situated at the internal border of the femoral vein, as a portion of that sheath. “ In all the dissections of femoral herniæ (says Mr. Guthrie) I have had an opportunity of making, the septum crurale of Cloquet, or the fascia propria of Sir Astley Cooper, formed a distinct sac, separated from the septum on the inside of the femoral vein, by a mass of condensed cellular structure, sometimes more than half an inch in thickness. The septum had been elongated into an outer sac for the hernia, and had gone down by the side of the sheath of the vein. The hernial sac, or peritoneum, is not then projected into the sheath of the femoral vessels, but into a separate sac, which it forms for itself by the side of them.” (*On Inguinal and Femoral Herniæ*, p. 32.) Here the difference of opinion turns entirely upon the point, whether the passage for the absorbent vessels at the inner side of the septum, or the pubic edge of the vein, is a compartment of the femoral sheath or not.

In every dissection of femoral hernia, performed by Mr. Todd, this thin fascia, the septum crurale, was sufficiently evident. It appears to him, however, that the fascia propria “ is formed, not only of a portion of this thin internal fascia, but also, in many instances, of all the dilatable parts interposed between the hernial sac and the superficial fascia; and that its thickness will depend on the thickness and structure of these parts; on the alterations produced in them by inflammation and pressure; and on the perforated portion of the crural sheath, in some cases, composing a layer of this fascia; while, in others, the hernia dilates, and is protruded through one of the foramina, frequently pushing before it a large absorbent gland from the orifice of the sheath.” (*C. H. Todd, in Dublin Hospital Reports*, vol. i. p. 248.)

As explained by Sir A. Cooper, a weak aponeurosis, derived from the superficial fascia of the bend of the thigh, covers the swelling, and lies immediately beneath the skin and adipose substance. Under this fascia is the condensed cellular substance or fascia propria joined with the expansion of the crural sheath, then some adipose substance, and lastly, the true peritoneal sac itself. It is of infinite use to remember these several investments in operating, lest the hernial sac should be supposed to be divided, while it is not so.

All late writers on hernia, have remarked how very small the aperture is, through which the viscera protrude in the femoral rupture; how much greater the constriction generally is, than in the bubonocele; consequently, how much more rapid the symptoms are; how much less frequently the taxis succeeds; and how much more dangerous delay proves. (See *Sir A. Cooper, Hey, Lawrence*, &c.)

Though the crural ring is almost always small, yet, in a few instances, in which the tumour is large, and of long standing, it becomes very capacious, just as the opening often becomes, through which the inguinal hernia protrudes. Dr. Thomson, of Edinburgh, Mr. Hey, and Mr. Lawrence, have related examples of this kind.

The remarks already made, concerning the treatment of hernia, before having recourse to the knife, are all applicable to the present case, and need not be repeated. In attempting to reduce the femoral hernia by the taxis, the surgeon should recollect, however, that relaxing Poupart’s ligament, and the femoral fascia, is of the highest consequence. Hence, the thigh should be bent, and rolled inwards. The pressure ought, also, to be first made downwards, in order to push the swelling off Poupart’s ligament; and afterwards, the parts should be propelled backwards, and then upwards, so that they may return through the crural canal and ring. For the direction of the crural canal is vertical in the greater part of its extent; its superior aperture faces upwards and backwards towards the abdominal cavity, whilst its inferior (the opening for the vena saphæna) is directed forwards. The canal, therefore, has three different axes, which by their union, represent the form of the letter Z; the superior branch of which, resting upon the pubes, would form the axis of the superior aperture of the canal, and which has a direction downwards and forwards. Its middle branch would represent that of the canal itself, which is vertical; whilst the inferior would pass rout directly forwards, through the opening for the vena saphæna, in a direction corresponding to the axis of this aperture. (See *M. Jules Cloquet, On Inguinal and Femoral Hernia*, p. 37. tr. by *McWhinnie.*)

Operation for the Femoral, or Crural Hernia.

Sir A. Cooper says, "The incision of the integuments is to be begun an inch and a half above the crural arch, in a line with the middle of the tumour, and extended downwards to the centre of the tumour below the arch. A second incision, nearly at right angles with the other, is next made, beginning from the middle of the inner side of the tumour, and extending across it to the outer side, so that the form of this double incision will be that of the letter T reversed." The angular flaps are, of course, to be next dissected off, and reflected. Dupuytren also makes the external wound of a similar shape, the first cut being always parallel to the femoral vessels. (*Breschet, Op.* cit. p. 169.)

The making of two incisions, however, is not deemed necessary by the majority of surgeons; and, in all the numerous operations which I have seen performed in St. Bartholomew's Hospital during my apprenticeship there, and afterwards, and in eight cases, upon which I have operated myself, a transverse wound was not necessary. The division of the skin should begin about an inch above the crural ring, and be continued obliquely downwards and outwards. In this manner, we cut exactly over the place, where the incision of the stricture should be made. (See *Lawrence*, p. 425. ed. 4.)

"The first incision (Sir A. Cooper remarks) exposes the superficial fascia, which is given off by the external oblique muscle, and which covers the anterior part of the hernial sac; but, if the patient is thin, and the hernia has not been long formed, this fascia escapes observation, as it is then slight and delicate, and adheres closely to the inner side of the skin. When this fascia is divided, the tumour is so far exposed, that the circumscribed form of the hernia may be distinctly seen; and a person, not well acquainted with the anatomy of the parts, would readily suppose that the sac itself was now laid bare. This, however, is not the case, for it is still enveloped by a membrane, which is the fascia, that the hernial sac pushes before it, as it passes through the inner side of the crural sheath. This membrane, the fascia propria, is to be next divided longitudinally from the neck to the fundus of the sac; and if the subject is fat, an adipose membrane lies between it and the sac, from which it may be distinguished, by seeing the cellular membrane passing from its inner side to the surface of the sac.

"This is, in my opinion, the most difficult part of the operation; for the fascia propria is very liable to be mistaken for the sac itself; so that, when it is divided, it is supposed, that the sac is exposed, and the intestine is laid bare: following upon this idea, the stricture is divided in the outer part of the sac, and the intestine, still strangulated, is pushed, with the unopened sac, into the cavity of the abdomen.

"The hernial sac being exposed, is to be next opened; and, to divide it with safety, it is best to pinch up a small part of it between the finger and thumb; to move the thumb upon the finger, by which the intestine is distinctly felt, and may be separated from the inner side of the sac; and then to cut into the sac, by placing the blade of the knife horizontally. Into this opening, a director should be passed, and the sac opened from its fundus to the crural sheath." (*On Crural and Umbilical Hernia.*)

Sometimes the contents of the hernia, thus exposed, admit of being returned, without the further use of the knife. When this object, however, cannot be readily done, the protruded parts should never suffer injury from repeated manual attempts; and it is best to divide the stricture at once.

The merit of having first proposed the safest plan of cutting Poupart's ligament, even before surgeons were aware of the parts which really form the strangulation, is assigned by Gimbernat to Mr. B. Bell, who introduced his finger below Poupart's ligament, between the ligament and the intestine (an evident proof, says Gimbernat, that there was no strangulation there); he then made a very superficial incision from above downwards into the thickest part of the ligament to its lower edge; and, without cutting quite through it, he continued his incision about an inch. He rested the back of the scalpel upon his finger, which served as a guide to the instrument, and, at the same time, as a defence to the intestine. The incision, however, having been continued for an inch, would, as Gimbernat remarks, inevitably cut the internal edge of the crural arch. Now, cutting this, only for a few lines, gives sufficient room for the easy reduction of the parts, and there is no necessity to touch the ligament, as it never occasions the strangulation. (*Gimbernat*, p. 27.)

Gimbernat's method of dividing the stricture, in cases of femoral herniæ, is now frequently regarded as the safest and most effectual. "Introduce, along the internal side of the intestine, a canulated or grooved sound with a blunt end, and a channel of sufficient depth. This is to be directed obliquely inwards, till it enter the crural ring, which will be known by the increased resistance; as also when its point rests upon the branch of the os pubis. Then suspend the introduction; and keeping the sound (with your left hand, if you are operating on the right side, and v. v.) firmly resting upon the branch of the os pubis, so that its back shall be turned towards the intestine, and its canal to the symphysis pubis, introduce gently with your other hand, into the groove of the sound, a bistoury, with a narrow blade and blunt end, till it enter the ring. Its entry will be known, as before, by a little increase of resistance. Cautiously press the bistoury to the end of the canal; and employing your two hands at once, carry both instruments close along the branch to the body of the os pubis, drawing them out at the same time. By this easy operation, you will divide the internal edge of the crural arch at its extremity, and within four or five lines of its duplicature; the remainder continuing firmly attached by the inferior band, or pillar, of which it is the continuation. This simple incision being thus made, without the smallest danger, the internal border of the arch, which forms the strangulation, will be considerably relaxed, and the parts will be reduced with the greatest ease. (*Gimbernat*, p. 45, 46.)

Mr. Lawrence thus executes Gimbernat's plan:— "It will generally be practicable (says he) to introduce the tip of the finger, or of the nail, under the edge of the tendon, the fibres of which should be carefully divided in succession, with the probe-pointed knife, until we have gained just sufficient room to replace the contents of the swelling. When the tightness of the stricture prevents the operator from using his finger as a guide, he will employ the deeply-grooved curved director, introducing it as near as he can to the pubes. In both cases, the blunt end only of the curved knife should be passed beyond the stricture, that the division may be effected without risk to the arteries, in case they should not follow their usual course." The intestine should be protected by the operator's left fore-finger, or, if that cannot be spared, it may be held aside by an assistant. (*On Ruptures*, p. 432. ed. 4.)

Mr. Todd has always found the division of a few fibres of Gimbernat's ligament effectual. (*Dublin Hospital Reports*, vol. i. p. 254.) The following are his directions : after the sac has been opened, "let the operator pass the fore-finger of his left hand (if the hernia be on the right side, and *vice versa*,) as far as he can, without using force, into the neck of the sac, the back of the nail being turned towards the pubes, and its extremity applied to the edge of Gimbernat's ligament. Sir Astley Cooper's bistoury is then to be introduced, the finger serving as a conductor for it, the bistoury being held so, that its edge shall look towards Poupart's ligament, and one of its sides be in contact with the nail of the conducting finger, between which, and Gimbernat's ligament, it is to be passed. Having ascertained with the blunt extremity of the bistoury, that it is fairly introduced into the crural ring, the intestine being protected, as much as possible, by the left hand of the operator, the edge of the bistoury is to be turned towards the pubes, and being pushed a little further into the ring, the sharp portion of its edge will be brought into contact with Gimbernat's ligament, and will divide a few fibres of it. The operator is still to keep the conducting finger between the intestine and bistoury, as thus he will be enabled to perceive the dilatation of the ring, and to judge of the extent to which it may be necessary to enlarge it." (*C. H. Todd.*)

Sir A. Cooper recommends the stricture to be divided "obliquely inwards and upwards, at right angles to the crural arch." In consequence of the very deep situation of the posterior edge of the crural arch, and the tight manner in which the protruded viscera are surrounded by the tendon, this excellent surgeon considers, that the intestine is in great danger of being wounded with the knife, or, if held aside sufficiently, of being torn. Hence, his custom is to divide the stricture on its anterior part, as far as the front margin of the crural arch, directing the edge of the knife upwards and inwards. If this is not sufficient, he afterwards cuts the thin posterior border of the tendon in the same direction.

After advising us to open the sac of a femoral hernia with particular care, on account of its being much thinner than that of a bubonocele, and (as might be added) on account of its seldom containing any fluid, and often having no omentum in it covering the intestine, Mr. Hey remarks : "The stricture made upon the prolapsed parts is very great, as I have already observed ; but if the tip of the finger can be introduced within the femoral ring, to guide the bubonocele knife, a small incision (for the ring is narrow) will be sufficient to set the parts at liberty. If the tip of the finger cannot be introduced at the proper place, a director with a deep groove must be used instead of the finger ; but I prefer the latter. The finger or director should not be introduced very near the great vessels, but on that side of the intestine or omentum which is nearest to the symphysis of the ossa pubis. *The incision may then be made directly upwards.* The surgeon must take especial care to introduce his finger or director within that part where he finds the stricture to be the greatest, which, in this species of hernia, is the most interior part of the wound." (P. 155.)

Gimbernat's mode is preferable to Mr. Hey's, because, were the operation done on a male, cutting directly upward would endanger the spermatic chord. In order to obviate this risk, Sir A. Cooper makes a small incision above Poupart's ligament, and draws the chord out of the way of the knife, with a bent probe.

Mr. Lawrence has noticed, that an "incision of the most interior part of the stricture is free from all danger in the ordinary course of the vessels. But that variety, in which the obturatrix artery, arising from the epigastric, runs along the inner margin of the sac, seems to preclude us from cutting even in this direction." Hesselbach met with a remarkable instance of such irregularity in the origin and course of the obturatrix artery in the body of a female, in whom there were two small crural herniæ. On the right side, the epigastric and obturatrix arteries arose, by a common trunk, from the crural artery below Poupart's ligament. They soon separated from one another ; the epigastric taking its ordinary course upwards at the outer side of the neck of the hernial sac, while the obturatrix made a considerable turn, and ran transversely inwards over the strong fibres of the femoral ligament, and encircled the anterior and inner side of the neck of the hernia, whence it afterwards proceeded obliquely downwards and outwards, behind the horizontal branch of the os pubis, towards the obturator foramen. (*Hesselbach*, p. 52.) A mode of operating has been proposed (*Edin. Med. and Surg. Journal*, vol. ii. p. 205.), with the view of avoiding this danger. We are directed to make an incision through the aponeurosis of the external oblique muscle, just above the crural arch, and in a direction parallel to that part ; to introduce a director under the stricture from this opening, and to divide the tendon to the requisite extent, by means of a curved knife passed along the groove. (*On Ruptures*, p. 430. ed. 4.) For reasons which Mr. Lawrence states, this plan is certainly not altogether eligible ; and, upon the whole, Gimbernat's method of cutting the stricture is safer.

Dupuytren uses a curved probe-pointed bistoury, that cuts with its convexity : it is conducted flat on the left fore-finger, and with it, under the stricture, and then its edge is turned upwards, the incision being extended through the upper end of the falciform process to the margin of the crural arch. (*Breschet, Concours, &c.* p. 182.)

It is remarked by Mr. Guthrie, that the falciform process, which lies over the femoral artery, and passes inwards to attach itself to Poupart's ligament, and to form the anterior part of Gimbernat's ligament, is inserted also into the os pubis, on a plane lower, than the insertion of the inferior pillar of Poupart's ligament, so that "it forms an arch, exterior to the septum crurale, which, when it is forced to descend, is compelled to pass under it ; *and it is this, and not Poupart's ligament,* which causes the greatest compression on the hernia, and is the seat of external stricture." (*Op.* cit. p. 32.)

This gentleman has heard of more than one instance, in which the obturatrix artery was wounded by dividing Gimbernat's ligament horizontally: he is therefore in favour of dividing directly upwards, "that portion of the fascia lata, which is attached to Gimbernat's ligament, and to the pubes, as well as the fascia propria." If this should be insufficient, he would then have recourse to the horizontal incision.

Monro computes, that the obturator artery may arise from the epigastric once in twenty-five or thirty subjects. But, allowing that it originates more frequently, it then does not always deviate from its usual course along the outside of the sac. Sir A. Cooper says, "In all cases, which I have myself dissected, where this variety existed with crural hernia, the obturator has passed into the pelvis, on the outer side of the neck of the sac, entirely out of the reach of any danger of the knife." (*On Crural Hernia*, p. 21.) Mr. Lawrence concludes, that the comparative number of instances, in which it is found on the opposite side, cannot be more than one in twenty, and consequently, if we admit that the obturatrix artery arises from the epigastric once in five times, it would only be liable to be wounded once in a hundred operations. (P. 412. ed. 3.)

When the origin and course of the epigastric artery differ from what is common, this vessel, as Hesselbach remarks, sometimes passes inwards along the horizontal branch of the os pubis, ere it ascends towards the rectus muscle; and when this variation exists in a case of femoral hernia, the artery does not pass over the outer side of the neck of the sac, but first under it, and then round its inner side. Hesselbach has seen only one instance of this irregularity of the epigastric artery in a female, and never in a male subject. (*Ueber den Ursprung, &c., der Leisten und-Schenkelbrüche*, p. 52.)

The industrious Cloquet examined 250 bodies, for the purpose of estimating the average number of cases, in which the origin and course of the obturatrix artery are different from what is most common. He found, that when this artery and the epigastric arise by one common trunk, they sometimes separate from each other above, and rarely below, the upper opening of the crural canal. In the first case, the longer their common trunk is, the closer do they lie to Gimbernat's ligament, and to the inner edge of the upper opening of the above canal. In the second case, the common trunk of these arteries arises within this canal, and the two vessels then return into the abdomen. In 160 bodies, of which 87 were male, and 73 female, the obturatrix artery arose on both sides from the hypogastric; and only in 56, of which 21 were male, and 35 female, did it originate on both sides from the epigastric. In 28, of which 15 were male, and 13 female, the obturatrix arose on one side from the hypogastric, and on the other from the epigastric. In six bodies, viz. two male, and four female, it originated from the crural. (*Rech. Anat. sur les Hernies*, 4to. Paris.)

It is observed by Professor Scarpa, that "the round ligament of the uterus, in passing through the abdominal muscles, follows precisely the same track as the spermatic chord. It is equally situated behind Poupart's ligament, with the difference, that it does not become so distinct from the internal xtremity of this ligament, as the spermatic chord does, because it has not so far to run, in order to get from that ligament to the inguinal ring, the latter opening being situated lower in the female than the male subject. The round ligament, like the spermatic chord, also crosses the epigastric artery, before reaching the inguinal ring. And as the crural hernia always begins at the internal and inferior angle of the arch of this name, as well in the male as the female, it follows that, in the two sexes, the epigastric artery remains in its natural situation, and invariably corresponds to the external side of the neck of the crural hernia; whilst the spermatic chord in men, and the round ligament in women, pass over the extremity of the front of the neck of the hernial sac. In the operation for the crural hernia, in females, the incision of the neck of the hernial sac, and crural arch, when directed upward towards the linea alba, cannot wound the epigastric artery, which it is of the most consequence to avoid; but it always divides, either totally, or partially, the round ligament of the uterus, which cannot lead to any dangerous hemorrhage; for, except in the period of pregnancy, the arteries of the round ligament are very small; they are almost obliterated in women advanced in years; and, in general, they are quite capillary in the extremity of the ligament adjoining the ring. Hence, it cannot be surprising, that so many crural herniæ have been successfully operated upon in women, by cutting the hernial sac and crural arch directly upward, while not a single instance can be cited of such an incision being made in man without mischief, although, in both sexes, the epigastric artery may have been avoided in operating by this process." (*Scarpa, Traité des Hernies*, p. 240.)

In operating upon the crural hernia in males, Scarpa recommends us to follow a method, which he calls new, but which, in fact, is the same as that advised by Gimbernat. "I have found (says Scarpa) that, in man, the neck of the hernial sac may be divided without danger, by giving to the incision a direction exactly contrary to that which is practised in the female subject. After having opened the hernial sac, it is to be drawn outward by one of its sides sufficiently to allow the introduction of a small director between its neck and the strangulated intestine, *the groove of the instrument being turned downwards towards the internal and inferior angle of the crural arch. A probe-pointed bistoury, the edge of which is also to be directed downwards towards the point of insertion of Poupart's ligament to the pubes, is to be pushed along the groove. By this means the neck of the hernial sac will be divided its whole length, at its internal and inferior side, and Poupart's ligament will be cut close to its attachment, to the top of the os pubis.* The epigastric artery will certainly be avoided, because it lies upon the opposite side of the hernial sac. As for the spermatic chord, I have demonstrated, that it is situated on the forepart of the neck of the hernial sac; consequently, it cannot be touched by an incision made from above downwards, whilst it is constantly cut in the ordinary method, since the knife is carried from below upwards. In the first case, this part may be the more easily avoided, as it lies at some distance from the internal and inferior angle of the crural arch. In fact, it is at this place that it quits, as we have seen, the edge of Poupart's ligament, in order to ascend towards the inguinal ring. The incision that I propose (says Scarpa) not only has the advantage of slitting open the neck of the hernial sac its whole length, it also divides a part of the insertion of Poupart's ligament into the upper part of the os pubis, a thing that greatly contributes to relax the crural arch, and facilitate the reduction of the viscera; of those, at least, which are not adherent to the sac." (*Scarpa, Op.* cit. p. 235.)

Hesselbach considers an incision through the outer side of the crural ring safer than one through Gimbernat's ligament; and safer in women than men. In women, he recommends the cut to be made through the middle of the fore part of the ring, nearly straight upwards, or a little inclined inwards, in which mode the epigastric artery cannot be hurt, whether it lie at the outer, or inner side of the neck of the sac. In men, this incision, directed obliquely upwards and inwards, he says, cannot be made, on account of the nearness of the spermatic chord: therefore, in the male subject, he advises cutting the inner side of the opening, that is to say, Gimbernat's or the femoral ligament, directly inwards towards the symphysis of the os pubis. (*Ueber den Ursprung der Leisten-und-Schenkelbrüche*, p. 54.) When the epigastric, or obturator, artery deviates from its usual course, and surrounds the inner side of the neck of the hernia (which variety can never be ascertained *a priori*), a wound of the vessel Hesselbach regards as unavoidable.

From the views taken of femoral hernia in this article, I consider the unrestricted direction always to cut Gimbernat's ligament in the operation, to be erroneous. For, as Langenbeck has stated, the seat of strangulation may either be in the external aperture of the crural canal, or in an opening of the front or inner side of this passage, or in its inner opening, where indeed Gimbernat's ligament and the attachment of the falciform process of the fascia lata to it, are truly concerned. When the strangulation is of the two first descriptions, he states, that only the fascia lata need be cut; but, in the third, most frequent case, the inner semi-lunar edge of the crural ring should be divided. In all cases, says Langenbeck, whether the strangulation be caused by the inner or external opening of the crural canal, or by an aperture in the front parietes of this passage, the stricture must be cut inwards, as directing the cut in the least outwards would injure the epigastric artery. When it is perceived, in the operation, that the neck of the hernial sac is strangulated, close below and behind the external pillar of the abdominal ring, the inner opening of the crural canal must be divided inwards, with the knife directed along the horizontal ramus of the os pubis, under the external pillar of the ring, towards the symphysis of the pubes. If, in such a case, the knife were carried inwards and upwards, that part of Poupart's ligament forming the upper side of the crural canal might be cut and the spermatic artery injured. (*Neue Bibl.* b. ii. p. 133.)

Dr. Trüstedt has published some remarks, in favour of employing dilatation, instead of an incision, in the operation for the strangulated crural hernia. He observes, that even when the common trunk of the obturatrix and epigastric arteries is short, the bowels may protrude under the first of these arteries, which will lie upon the upper and inner side of the hernia. In an operation performed upon a woman, in La Charité at Berlin, for a strangulated femoral hernia, the crural ligament was divided in Gimbernat's way by an incision, exactly parallel to the horizontal ramus of the os pubis, and the obturatrix artery was wounded. The patient died eight days after the operation, having been previously attacked by trismus and opisthotonos. On dissection, about six ounces of putrid blood were found in the lesser cavity of the pelvis, and the above artery cut. The vessel arose from the epigastric, ran over the upper edge of the inner opening of the crural canal, or ring, and then descended along its inner edge, towards the obturator foramen. This occasional course of the obturatrix artery leads Dr. Trüstedt to suggest the following rules:—If, after the hernial sac is opened, the bowels cannot be returned, the outer opening of the crural canal should be cut directly inwards, in order to produce a considerable relaxation. But, if the reduction should yet be impracticable (the strangulation being at the inner opening of the canal), then an attempt is to be made to insinuate the end of the finger through the constriction; a plan said to have answered very often in the practice of Surgeon-General Rust. Should the resistance be too great, however, for this method to succeed, Trüstedt advises the crural ligament to be forcibly drawn inwards and upwards towards the navel, with Arnaud's tenaculum, assisted by the introduction of the finger, or with two hooks. When this plan fails, he recommends Schreger's practice of dividing the anterior edge of Poupart's ligament with a pair of blunt-pointed scissors, and then the use of Arnaud's tenaculum again. (See *Rust's Magazin für die gesammte Heilkunde*, b. iii. h. 2.) The consideration, however, which will ever prevent the common adoption of Dr. Trüstedt's suggestion, is, that fifty times more lives would be lost by the mischief done to the protruded bowels by the forcible introduction of the fingers and hooks, than by hemorrhage from the obturatrix, or epigastric artery, when the course of the vessel is irregular.

Mr. Aston Key, who is an advocate for not opening the sac, makes the following remarks. The inverted T incision, usual in the operation for femoral hernia, may be, in most cases, reduced to a single incision, either at right angles to Poupart's ligament, or in a transverse direction across the tumour. "I have not (says he) made trial of the perpendicular form of incision, but a single transverse one I have found sufficient, when the integuments have been loose, and the tumour not large. The superficial fascia adheres firmly to the common integuments, and is usually turned aside with them, especially when the latter are pinched up for the purpose of making the first incision. The fascia propria is, therefore, quickly exposed, and forms the first distinct covering of the tumour, being darker than the more superficial investment. It is under the outer layer of this fascia, that the adipose structure is formed, which often assumes the appearance of omentum. The director easily makes its way under this fatty matter, as far as the neck of the sac, which lies deeper than the operator at first supposes. The point of the director should be applied rather to the inner, than to the outer part of the neck of the sac, as it will be found to pass more easily under the stricture at this part. It should not at first be attempted to be thrust under the stricture, as the firmness of the parts, forming the stricture, would resist it. But the seat of stricture being felt, the operator should depress the end of the director upon the sac, which will yield before it, and then, by an onward movement, the director slides under the stricture." Mr. Key takes the opportunity of remarking, that the constriction, at the femoral aperture, is not entirely produced by a process from Poupart's ligament, but, in part, by a tendinous band on the forepart of the femoral sheath, when the fascia transversalis passes in a funnel-form behind Gimbernat's ligament to be inserted into the pubes. (See *Mem. on the Advantages of dividing the Stricture, &c., on the outside of the Sac*, p. 142—145. 8vo. Lond. 1833.)

Of late years, a fact of considerable interest has been ascertained in relation to femoral hernia; viz. that the constriction of the bowel by the smallness of the aperture and the sharp edge of Poupart's ligament, is so great, that either a permanent contraction of the part, ulceration of the internal and muscular coats, or even that of the serous coat also may occur, followed by fatal extravasation, after the reduction of the hernia by the operation. (*Chevalier, in Med. Chir. Trans.* vol. iv. p. 324.; *Breschet, Op.* cit., obs. 2.; *Lawrence*, p. 442. ed. 4.) Hence, the latter gentleman is an advocate for gently drawing out the bowel, after liberating it from stricture: if no reason be found to apprehend perforation of the tube, he advises its reduction; but, in the opposite case, he directs it to be left out of the abdomen, rather than that the patient should be exposed to the danger of effusion into the abdomen. (P. 444.)

Congenital Hernia.

Before the beginning of the sixth month of the fœtal state, the testicle is situated just below the kidney, upon the psoas muscle, where it receives its arteries from the aorta, and sends its vein on the right side into the lower vena cava, and, on the left, into the renal vein; and where also it receives a covering from the peritoneum, just like the other abdominal viscera. From the lower part of the testicle and epidydimis proceeds a long fibrous substance, called the *gubernaculum*, and it lies in the track which that organ afterwards follows in its descent into the scrotum. The gubernaculum is believed to have some influence in guiding the testicle in the right course to its final situation. Between the beginning of the sixth month, and end of the seventh, the testicle has either descended as low as just above the abdominal ring, or else is passing through it, or arrived a little below it. (*Wrisberg. Comm. Reg. Societ. Götting.* 1785.)

When the testicle passes through the abdominal ring into the scrotum, it is received into a production of the peritoneum, which afterwards constitutes the tunica vaginalis; while that peritoneal investment, which was given to the testicle in the loins, is closely adherent to this body, and forms what is named the tunica albuginea.

According to Sir Astley Cooper, it is in the eighth month, that the testis passes out of the abdominal ring, "bringing with it a portion of the peritoneum, which is previously somewhat looser at the lower part of the abdomen, than elsewhere, and which becomes afterwards the tunica vaginalis." (*On Hernia*, part i. p. 74. ed. 2.)

After the descent of the testicle into the scrotum, the communication, between the cavity of the tunica vaginalis and that of the abdomen, commonly becomes obliterated, which latter event is usually effected before birth, sometimes not till afterwards; and, in a few subjects, even as late as the adult state.

In the congenital hernia, the protruded viscera are situated in the tunica vaginalis, in contact with the testicle; having descended into this position before the closure of the communication with the abdomen. Of course, the tunica vaginalis itself is the hernial sac. The nature of this case was not understood, until it was elucidated by Haller in 1755, and the two Hunters in 1762 and 1764. (See *W. Hunter's Med. Comment.; Haller's Opuscula Patholog. and Opera Minora, S.*) Before the periods here specified, surgeons imputed the circumstance of the contents of the hernia and testicle being in contact, to the bowels having made their way, by laceration, through the tunica vaginalis, from the ordinary hernial sac of a bubonocele.

From the term *congenital*, we might suppose, that this hernia always existed at the time of birth. The protrusion, however, seldom occurs till after this period, on the operation of the usual exciting causes of herniæ in general. It does not commonly happen till some months after birth; and, in certain instances, not till a late period. Mr. Hey relates a case, in which a hernia congenita was first formed in a young man, aged sixteen, whose right testis had, a little while before the attack of the disease, descended into the scrotum. In the generality of cases, which actually take place when the testicle descends into the scrotum before birth, the event may be referred to that organ having contracted an adhesion to a piece of intestine, or omentum, in its passage to the ring. In an infant, which died a few hours after birth, Wrisberg found one testicle, which had not passed the ring, adhering, by means of a few slender filaments, to the omentum, just above this aperture. Sometimes, adhesions of the testicle to the adjacent viscera, instead of leading to the formation of a congenital hernia, only prevent the descent of the former organ. Cloquet examined the body of an old man, in which the left testicle lay on the psoas and iliacus muscles, connected to the sigmoid flexure of the colon, while an inguinal hernia existed on the same side. (*Recherches*, &c. p. 24.) Sometimes, no protrusion at all happens, even though the communication between the tunica vaginalis and abdomen continue open in the adult subject, as is particularly exemplified in a case, recorded by Hesselbach, where such communication existed on each side in a man, thirty-eight years of age, without any hernia. (*Med. Chir. Zeitung*, 1819, p. 110.) The hernia may protrude for the first time in an adult. (See *Case by Sir A. Cooper, On Hernia*, part i. p. 75. ed. 2.)

The appearance of a hernia in very early infancy, Mr. Pott observes, will always make it probable that it is of this kind; but, he was not correct in asserting, that in an adult, there is no reason for supposing his rupture to be of this sort, but his having been afflicted with it from his infancy; and that there is no external mark, or character, whereby it can be certainly distinguished from one contained in a common hernial sac. This statement is erroneous, inasmuch as the hernia congenita, while the bowels are down, is attended with difficulty or impossibility of feeling the testis, which part in the common scrotal hernia is always distinguishable under the fundus of the hernial sac.

Mr. Pott notices, that "in very young children, a piece of intestine, or omentum, may get pretty low down in the sac, while the testicle is still in the groin, or even within the abdomen. In this case, the application of a truss would be highly improper; for, in the latter, it might prevent the descent of the testicle from the belly into the scrotum; in the former, it must necessarily bruise and injure it, give a great deal of unnecessary pain, and can prove of no real use. Such bandage, therefore, ought never to be applied on a rupture in an infant, unless the testicle can be fairly felt in the scrotum, after the gut or caul is replaced; and when it can be so felt, a truss can never be put on too soon." This is also the advice delivered by Sir A. Cooper.

As Mr. Pott has explained, an old rupture, originally congenital, is subject to a stricture made by the sac itself, as well as to that produced by the abdominal ring, or, as might have been added, to that caused by the superior opening of the inguinal canal. The fact he noticed several times, both in the dead and in the living. "I have seen (says he) such stricture made by the sac of one of these herniæ, as produced all those bad symptoms which render the operation necessary: and I have met with two different strictures, at near an inch distance from each other, in the body of a dead boy, about fourteen, one of which begirt the intestine so tight, that I could not disengage it without dividing the sac.

"In this kind of hernia I have also more frequently found connections and adhesions of the parts to each other, than in the common one; (See also *Sir A. Cooper, Op.* cit. part i, p. 78.) but there is one kind of connection sometimes met with in the congenital hernia, which can never be found in a common hernial sac, and which may require all the dexterity of an operator to set free; I mean that of the intestine with the testicle.

"If a large quantity of fluid should be collected in the sac of a congenital hernia, and, by adhesions and connections of the parts within, the entrance into it from the abdomen should be totally closed, (a case which I have twice seen) the tightness of the tumour, the difficulty of distinguishing the testicle, and the fluctuation of the fluid, may occasion it to be mistaken for a common hydrocele; and if, without attending to other circumstances, but trusting merely to the feel and look of the scrotum, a puncture be hastily made, it may create a great deal of trouble, and possibly do fatal mischief." (*Works*, vol. ii.)

This complication may be known by returning all the contents of the tumour into the abdomen, while the patient is in the horizontal posture. "Then, by putting the finger against the abdominal ring, the water will slip by it, and fall down into the scrotum, producing a transparent tumour, or true hydrocele; after which, if the pressure of the finger is a little lessened at the ring, and the patient is desired to cough, the intestine and omentum will be felt falling down into their former situation." (See *Sir A. Cooper, on Hernia*, part i. p. 75. ed. 2.)

Mr. Pott also believed, that common ruptures, or those in a peritoneal sac, are generally gradually formed, that is, they are first inguinal, and by degrees become scrotal; but that the congenital are seldom remembered by the patient to have been in the groin only. As the tunica vaginalis is thicker than the peritoneum, the contents of a congenital hernia are not so easily felt, as those of a common rupture. In children, the hernia generally contains intestine only, the omentum not being in them sufficiently long commonly to protrude.

The sac of a congenital hernia, especially when the case is strangulated, is every where equally tense, (*Hesselbach*, p. 36.) and below it the testis cannot be felt.

The reader must not conclude, however, from the above account, that every rupture in children is congenital. Mr. Lawrence has related a case of strangulated bubonocele, which took place in an infant only fourteen months old. (P. 65. ed. 3.)

The common inguinal hernia, which first protrudes at the inner opening of the inguinal canal, and which has the epigastric artery on the inner side of its neck, has been named by Hesselbach *external;* while the less common instance, in which the viscera burst directly through the aponeuroses of the transverse and internal oblique muscles, and pass directly out of the abdominal ring, leaving the epigastric artery on the outer side of the neck of the sac, is distinguished by the epithet *internal.* (*Anat. Chir. Abhandlung über den Ursprung der Leistenbrüche;* Würzb. 1806.) "The inguinal congenital hernia (says Scarpa) cannot be divided into *external* and *internal;* it is evident, that it must always be external, since the neck of the tunica vaginalis invariably corresponds to the point, at which the spermatic chord passes under the margin of the transverse muscle. As for other circumstances, the tunica vaginalis lies in its whole course in the same manner as the sac of a common inguinal hernia: like this, it passes completely through the inguinal canal from one end to the other, resting upon the anterior surface of the spermatic chord. Consequently, it passes between the separation of the inferior fibres of the obliquus internus, and the principal origin of the cremaster muscle. (See *Wrisberg. Syllog. Comment. Anat.* p. 23.) After coming out of the ring, as it is always united to the spermatic chord, it is enclosed in the muscular and aponeurotic sheath of the cremaster muscle, which accompanies it to the bottom of the scrotum. Since the tunica vaginalis, including the displaced viscera, enters the inguinal canal on the outside of the point, at which the spermatic chord crosses the epigastric artery, it is manifest, that, as it follows exactly the direction of this chord, it must also cross the artery, and remove it from the outer to the inner side of the ring, according to the mechanism already explained in speaking of the common inguinal hernia. Hence, the displacement of the epigastric artery constantly happens in the inguinal congenital, just as it does in the ordinary external inguinal hernia.

"But, if these two species of inguinal herniæ have some analogy to each other, in regard to the parts which constitute them, yet, they present some remarkable differences. 1. The common inguinal hernia, whether internal, or external, when it extends into the scrotum, cannot descend beyond the point at which the spermatic vessels enter the testicle. There the cellular substance of the spermatic chord terminates. There the hernial sac must also unavoidably terminate. On the contrary, in the congenital hernia, the viscera may descend lower than the testicle, with which they are in immediate contact; and, at length, they even occupy the situation of this organ, which is then pushed upward and backward. 2. In the case of a congenital hernia, the descent of the viscera from the groin to the scrotum commonly takes place in a very short time, and in some measure precipitately: it is much slower and more gradual in the ordinary inguinal hernia. The reason of this difference is very plain. In the first case, the descent of the testicle, and the formation of the tunica vaginalis, have opened and prepared the way, which the viscera must follow in forming a protrusion; while, in the second, the hernial sac cannot descend into the scrotum, but by gradually elongating the layers of the cellular substance, which joins it to the surrounding parts. This fact is so generally known, that experienced practitioners consider the promptitude, with which the viscera have descended from the groin to the bottom of the scrotum, as a characteristic sign of a scrotal congenital hernia." (*Scarpa, Traité des Hernies*, p. 73, &c.; *Hesselbach*, p. 35. *Pott*; *Sir A. Cooper*, part i. p. 79. ed. 2.)

In the hernia congenita, the spermatic artery and vein are sometimes on one side of it, and the vas deferens behind it. A preparation, exhibiting this alteration of the chord, may be seen in the museum of St. Thomas's Hospital.

If circumstances will admit of a truss being applied and worn, in cases of congenital hernia, in young subjects, there will be a considerable chance of a radical cure being effected, in consequence of the natural propensity of the opening between the abdomen and tunica vaginalis to become closed.

In the operation, the surgeon has to lay open the tunica vaginalis, instead of a common hernial sac; but, as Sir Astley Cooper judiciously recommends, that membrane should not be opened low down; 1st, because a sufficiency of it should always be left to cover the testicle; and, 2dly, because the spermatic artery and vein are situated obliquely on the front and lower portion of the tumour. The incision should begin at the upper part of the abdominal ring, and, in large herniæ, extend to a little above the testicle. This lays bare the fascia and cremaster muscle, which cover the tunica vaginalis. This latter membrane is then to be cautiously opened, and divided in the direction of the first incision, to within an inch of the abdominal ring above; but downwards no lower, than the upper part of the testicle, as a sufficient quantity of the tunica vaginalis should be left to cover this organ. (See *Sir A. Cooper, Op.* cit. p. 78. part. ii.) If the hernia were large, and it had been for any time irreducible, the same experienced surgeon would advise the return of the parts without inspection, if the stricture could be removed without opening the tunica vaginalis. The stricture is to be divided on the same principle as that of an inguinal hernia, and much in the same manner. As, in a case of congenital hernia, the parts are always protruded on the outside of the epigastric artery, the stricture may be safely divided towards the ilium, as well as directly upwards. (*Lawrence, On Ruptures*, p. 507. ed. 4.) The tunica vaginalis having been opened, the finger is to be passed into it, the seat of stricture ascertained, and, if this be at the abdominal ring, Sir A. Cooper recommends the dilatation to be made by insinuating the knife between the sac and the ring. "If, says he, "the impediment to the return of the hernia is formed by the transversalis muscle, the knife (still on the anterior side of the sac) is to be carried up to it, (the stricture) through the ring; but, if the stricture is in the tunica vaginalis itself, at its orifice into the abdomen, the knife must be introduced within it, and the strictured part cautiously divided." (*Op.* cit. part ii. p. 78.) According to Sir Astley Cooper, the stricture is generally about an inch and a half from the abdominal ring, except in large cases, when it is nearer to it. The parts having been reduced, the edges of the wound are to be brought together, and retained so by means of one or two sutures, and sticking-plaster.

Instances of strangulated congenital inguinal hernia in young children, are exceedingly rare. Their possibility, however, should be remembered, and even the occasional necessity for operating. Thus, Mr. Adams was called upon to perform the operation on a child, eighteen months old, with this species of hernia strangulated; and the case ended favourably. (See *Dublin Journ. of Med. Science*, vol. ii. p. 321.)

A new species of hernia congenita was described by the late Mr. Hey, in which a sac, containing the viscera, is included in the tunica vaginalis. He conceived, that it arose from the parts being protruded, after the communication between the abdomen and tunica vaginalis had been closed, but not effectually, so that the peritoneum was carried down along with the intestine, and formed a hernial sac within the tunica vaginalis. Such a hernia can only be produced, while the original tunica vaginalis remains, in the form of a bag, as high as the abdominal ring. Sir Astley Cooper believes, that the tunica vaginalis becomes closed at the ring, but remains open above and below it. (*On Hernia*, part. i. ed. 2.) Mr. Hey called the case *hernia infantilis*; Sir A. Cooper *encysted vaginal hernia*. The testis is not involved, and can be distinctly felt below the hernia. The tunica vaginalis ought, in this case, to be freely opened. The strangulation, which arises from the contracted state of the mouth of the sac, may be safely divided, either upwards, as directed by Sir Astley Cooper, or upwards and outwards. Operators should be aware of the possibility of having a sac to divide, after laying open the tunica vaginalis. (See *Hey's Practical Obs.* p. 221. *Dr. Ballingall, in Edin. Med. Journ.* No. 87, p. 464.; and *Sir A. Cooper's Work On Hernia*, p. 79. part i. ed. 2.)

Mr. C. H. Todd mentions various anatomical facts, which convince him, that "the generally received opinion, respecting the formation of hernia infantilis, is erroneous; and that, in no instance, is the sac in actual contact with the testicle." Mr. Todd believes, that the hernial sac is protruded completely within the cellular sheath of the chord; and that, when it depends near to the point of insertion of the spermatic vessels into the testicle, its fundus comes in contact with the upper part of the tunica vaginalis testis, and receives from it, on its lower surface a serous covering, proportioned to the magnitude of the tumour, or degree of distension of the sac. He also thinks, that, although this hernia is more easily formed in an infant, it may occur at any period of life. In University College Hospital, two examples of this hernia have occurred in adult persons, within the last two years. It is a case that appears to be often combined with hydrocele. The most certain diagnostic symptoms, seem to Mr. Todd to be; first, the testicle being situated at the lowest part of the hernia, although the tumour is unusually large. Secondly, the possibility of making the fluid in the tunica vaginalis, when a fluid is lodged in it pass, by means of a little pressure, for some distance in front of the hernial sac, towards the abdominal ring. If an operation were necessary for the relief of strangulation, Mr. Todd deems it quite practicable in many instances to open the hernial sac, without dividing the tunica vaginalis. The prudence of acting in this way, however, will depend on the extent of that part of the anterior surface of the sac, which is not covered by the serous membrane of the testicle. Mr. Todd would not extend the incision to the bottom of the tumour, and, after cautiously opening the sac, near the abdominal ring, he would make the dilatation of it downwards, the finger having been previously introduced to ascertain the distance to which the fundus of the sac depends. (See *C. H. Todd, in Dublin Hospital Reports*, vol. i. p. 232, &c.)

UMBILICAL HERNIA, OR EXOMPHALOS.

" The exomphalos, or umbilical rupture, (says Pott) is so called from its situation, and has (like other herniæ) for its general contents, a portion of intestine or omentum, or both. In old umbilical ruptures, the quantity of omentum is sometimes very great. Mr. Ranby says, that he found two ells and a half of intestine in one of these, with about a third part of the stomach, all adhering together. Mr. Gay and Mr. Nourse found the liver in the sac of an umbilical hernia; and Bohnius says, that he did also. But whatever are the contents, they are originally contained in the sac, formed by the protrusion of the peritoneum. In recent and small ruptures, this sac is very visible; but in old, and large ones, it is broken through at the knot of the navel, by the pressure and weight of the contents, and is not always to be distinguished; which is the reason why it has by some been doubted whether this kind of rupture has a hernial sac or not.

" Infants are very subject to this disease in a small degree, from the separation of the funiculus; but in general they either get rid of it as they gather strength, or are easily cured by wearing a proper bandage. It is of still more consequence to get this disorder cured in females, even than in males, that its return, when they are become adult and pregnant, may be prevented as much as possible; for at this time it often happens, from the too great distention of the belly, or from unguarded motion when the parts are upon the stretch. During gestation, it is often very troublesome, but, after delivery, if the contents have contracted no adhesion, they will often return, and may be kept in their place by a proper bandage.

" If such bandage was always put on in time, and worn constantly, the disease might in general be kept within moderate bounds, and some of the very terrible consequences which often attend it might be prevented. The woman who has the smallest degree of it, and who, from her age and situation, has reason to expect children after its appearance, should be particularly careful to keep it restrained

" In some the entrance of the sac is large, and the parts easily reducible; in others they are difficult, and in some absolutely irreducible. Of the last kind many have been suspended for years in a proper bag, and have given little or no trouble. They who are afflicted with this disorder, who are advanced in life, and in whom it is large, are generally subject to colics, diarrhœas, and, if the intestinal canal be at all obstructed, to very troublesome vomitings.—Hence, patients are often supposed to labour under a stricture, when they really do not. It therefore behoves such to take great care to keep that tube as clean and free as possible, and neither to eat or drink any thing likely to make any disturbance in that part." (*Pott on Ruptures*, vol. ii.)

The writings of Sir A. Cooper, Scarpa, (*Traité des Hernies*, p. 327.) and all the most accurate moderns, confirm the fact described by Pott, that in the umbilical rupture, there is a hernial sac, just as in other instances of herniæ. Every anatomist knows, that, behind the opening in the linea alba at the umbilicus, the peritoneum is complete, and consequently must protrude along with the viscera, in cases of exomphalos. In the only two cases which Sir A. Cooper had seen of a deficiency of the sac, the membrane has been partially absorbed, or lacerated, so as to allow the protrusion of its contents, and threaten, from this cause, a double stricture. Similar appearances, less closely inspected, probably gave rise to the opinion so firmly maintained by Dionis, De la Faye, Garengeot, and J. L. Petit, that, in the umbilical hernia, the peritoneum was always lacerated, and there was no hernial sac. Early infancy is most subject to *umbilical* hernia, strictly so called, in which the parts protrude through the navel; while the other periods of life are more liable to false umbilical herniæ, or such as arise in the vicinity of the umbilicus. (*Œuvres Chir. de Desault*, t. ii. p. 315.)

Besides a true hernial sac, the exomphalos is also covered by a more superficial expansion, consisting of condensed cellular substance. In operating, however, a surgeon should always cut with great caution; for the integuments and hernial sac, in front of the tumour, are inseparably adherent; and sometimes, in large cases, when an absorption of part of the sac has been caused by the pressure of the bowels, they are even found adherent to the integuments.

Pregnant women, and dropsical and corpulent subjects, are peculiarly liable to the exomphalos. In adults, when there is intestine in the sac, there is almost always omentum. The transverse arch of the colon is observed to be particularly often contained in umbilical hernia, but the small intestines are not unfrequently protruded: and even the cœcum has been found in a rupture at the navel. (See *Lawrence on Ruptures*, p. 454, 455. ed. 4.)

In the true umbilical hernia, the stricture is made by the tendinous opening in the linea alba. Let us next consider the umbilical hernia in the three particular forms, in which it has been noticed by the latest writers.

CONGENITAL UMBILICAL HERNIA.

Dr. Hamilton met with about two cases of this kind annually, for the space of seventeen years;

and they strictly deserve the epithet *congenital*, as they appear at birth. The funis ends in a sort of bag, containing some of the viscera, which pass out of the abdomen through an aperture in the situation of the navel. The swelling is not covered with skin, so that the contents of the hernia can be seen through the thin distended covering of the chord. The disease is owing to a preternatural deficiency in the abdominal muscles, and the hope of cure must be regulated by the size of the malformation, and quantity of viscera protruded.

The plans of cure proposed, consist of the employment of a ligature, or of a bandage. The latter seems preferable, and was practised by Mr. Hey, as follows:—Having reduced the intestine, he desired an assistant to hold the funis compressed sufficiently near the abdomen, to keep the bowel from returning into the hernial sac.

"I procured (says he) some plaster spread upon leather, cut into circular pieces, and laid upon one another in a conical form. This compress I placed upon the navel, after I had brought the skin on each side of the aperture into contact, and had laid one of the lips a little over the other. I then put round the child's abdomen a linen belt; and placed upon the navel, a thick, circular, quilted pad, formed about two inches from one extremity of the belt.

"This bandage kept the intestine securely within the abdomen, and was renewed occasionally. The funis was separated about a week after birth; and at the expiration of a fortnight from that time, the aperture at the navel was so far contracted, that the crying of the child, when the bandage was removed, did not cause the least protrusion. I thought it proper, however, to continue the use of the bandage a little while longer. A small substance, like fungous flesh, projected, after the funis had dropped off, about half an inch from the bottom of that depression which the navel forms. A dossil of lint spread with cerat. e lapide calaminari, and assisted by the pressure of the bandage, brought on a complete cicatrisation." (P. 227.)

This gentleman has related another example, in which the intestines were quite uncovered, and inflamed, the sac having burst in delivery. The parts were reduced, but the child died. (See also *G. A. Fried de Fœtu Intestinis plane nudis extra Abdomen propendentibus nato.* Argent. 1760.)

UMBILICAL HERNIA IN CHILDREN.

The umbilical hernia which is sometimes formed in the fœtus, from causes difficult of explanation, takes place, in other instances, at the moment of delivery; and then, as Sabatier remarks, should it be tied by mistake, with the funis, death would be the consequence. Most frequently, however, it is not till the second, third, or fourth month after birth, that the disease occurs; and the numerous cases, collected by Desault, prove that, of ten infants attacked with this hernia, nine become afflicted at the periods here specified.

The umbilicus, still open, now begins to contract, so as to close the cicatrix, which soon forms an obstacle capable of preventing a protrusion of the viscera. Sometimes, however, the repeated crying of the child propels the viscera through the opening, and thus the closure of the cicatrix of the navel is prevented. By degrees, the umbilical ring becomes more and more dilated, the quantity of protruded bowel increases, and thus a tumour arises, which, from being of trivial size at first, at length attains the size of an egg, or large walnut, and presents itself with all the characteristic marks of a hernia.

The presence of a piece of intestine and omentum in the tumour, keeps the umbilicus open, and opposes the continual tendency which it has to close. Such tendency, however, being sometimes superior to the resistance of the protruded parts, forces them back into the abdomen, obliterates the opening through which they passed, and thus the spontaneous cure of the umbilical hernia in children is accomplished. Two cases, illustrative of this fact, are related by Bichat. (*Œuvres Chir. de Desault*, t. ii. p. 318.)

Nature, however, does not effect many such cures; and when the case is left to her alone, she not only fails in bringing about a radical cure, but gradually renders it impossible. In short, the propensity of the opening to close diminishes, and is lost, as the subject grows older.

Thus, the umbilical hernia of children seems to be essentially different from that of adults, in the tendency of the aperture to contract. Hence the ease of effecting a radical cure in children, and the almost utter impossibility of doing so in adults. In the former, it is enough to keep the intestines from protruding, and the opening becomes of itself obliterated; in the latter, the opening always remains, whether the bowels continue in it or not. This indisposition of the aperture to contract in the adult, also frequently depends upon the protrusion not being through the umbilical ring itself, but through a fissure in the vicinity of it, not endued with the same natural tendency to close, which the umbilicus possesses in young subjects. In fact, it would appear from the observations of Scarpa, that, unless a grown up person has had the protrusion from infancy, it never occurs exactly through the umbilical ring itself.

The means of curing the umbilical hernia of children, are compression, and the ligature. The former is the most modern; the latter the most ancient treatment, being mentioned by Celsus. The design of both is the same, viz. to prevent the lodgment of the protruded viscera in the opening of the umbilicus, and thus facilitate the approximation of its sides. To accomplish this end, the ligature retrenches the hernial sac, and skin pushed before it; and, by the union of the cut parts, a cicatrix is produced, which hinders the protrusion of the viscera. At the same time, the sides of the opening, obeying their natural tendency, compression closes the deficiency, or opening, in the parietes of the abdomen, hinders the protrusion of the bowels, and keeps these parts from resisting the contraction of the sac. Desault's method, which much resembled that of Saviard, is described by Bichat. The child must be placed on its back, with its thighs a little bent, and its head inclined towards the chest. The surgeon is to reduce the protruded parts, and to hold them so with his finger, at the same time that he raises the hernial sac, and rubs its sides between his fingers, so as to be sure, that there is nothing contained in it. Being certain, that the parts, which he lifts up, are only the skin and sac, he is to direct an assistant to surround their base several times with a waxed ligature, of middling size, each turn being tied with a double knot, in such a manner as only to occasion little pain. The tumour, thus tied, is to be covered with lint, which is to be supported with one or two compresses, and a circular bandage, secured with a scapulary. By the following day, a slight swelling has commonly taken place in the constricted parts. On the second, or third day, the parts shrink, and then the ligature becomes loose, so that a fresh one must now be applied in the same manner as the first, taking care to draw it a little more tightly. The sensibility of the parts, increased by the inflammation, which the constriction of the ligature has already produced, usually renders this second ligature more painful. After the operation, the same dressings as at first are to be applied. The tumor soon becomes discoloured, livid, and smaller. A third ligature, put on in the same way as the preceding ones, entirely obstructs the circulation in it. The part turns black and flaccid, and commonly falls off on the eighth or tenth day. A small ulcer is left, which, being properly dressed, very soon heals, and leaves a cicatrix sufficiently strong to resist the impulse occasioned by coughing, or other efforts of the abdominal muscles. For two or three months, however, after the operation, the child should wear a circular bandage, in order to prevent, with still greater certainty, the viscera from being propelled against the cicatrix, so as to interrupt the process of nature, which is now producing a gradual closure of the umbilical opening.

Mr. Pott notices the plan of curing the exomphalos with the ligature, and expresses himself strongly against the practice in general. To adults the plan is not applicable. Mr. Pott was decidedly in favour of compression; and he observes, that in young subjects, and small herniæ, a bandage, worn a proper time, generally proves a perfect cure. (Vol. ii.)

Anxious that this work should be strictly impartial, I next proceed to relate what has been more recently urged against the employment of the ligature for the cure of the umbilical hernia in children.

The incessant care that a bandage requires, either to keep it clean, or make it always keep up the proper degree of pressure, renders its employment difficult in the children of the poorer classes. Scarpa expresses his opinion, that this was what induced Desault to revive the operation for the umbilical hernia by the ligature, nearly such as is described by Celsus; an operation (continues Scarpa), which, a long while since, and for good reasons, was altogether abandoned. Desault himself has put some restrictions to the employment of the ligature, since he observes, that this method does not radically cure the umbilical hernia of children, arrived at the age of four years; and, that, even in the youngest children, a radical cure cannot be effected by the ligature, unless a methodical compression of the navel, by means of a bandage, be kept up immediately after the operation, and for two or three months. It is perhaps to the omission of this last means, that a relapse is to be ascribed in several of the children operated upon by Desault. "*Desault avoit remis en vigueur la ligature tombée en désuétude. Il s'abusoit sur sa valeur; et il n'est pas difficile d'en connoître la cause. Tous les enfans qu'il opéroit à l'Hôtel-Dieu sortoient guéris, et n'y revenoient plus: on regardoit alors comme radicale une guérison momentanée.*" (*Richerand, Nosographie Chir.* t. ii. p. 453.) "I have carefully watched (says Scarpa) the immediate effects, and the more or less remote consequences of tying the umbilical hernia, either simply, or by means of a needle and double ligature; and, after a considerable number of such cases, I believe I can assert, that *this operation, howsoever performed, is not always exempt from grave and sometimes dangerous accidents. I can also add, that it never procures a truly radical cure, unless the cicatrix, occasioned by it in the umbilical region, be submitted for some months to a methodical and uninterrupted compression. It is not so uncommon, as some surgeons pretend, to see arise, after the application of the ligature, a fever attended with symptoms of most violent irritation, and acute sufferings, which cause incessant crying, and sometimes convulsions. The ulcer, which is produced by the detachment of the swelling, is always very large and difficult to heal. Every now and then, it becomes painful, and emits fungous granulations, even though dressed with dry applications.*

"Latterly, it has been explained by a celebrated surgeon (*Paletta Mémor. de l'Instituto*, tom. ii. part 1.), that the umbilical vein and the suspensory ligament of the liver, being included in the ligature of the umbilical hernia, the inflammation, which originates in these parts, may, perhaps, in certain cases, be communicated to the liver, so as to put the child's life in great danger. When, in consequence of the ligature, symptoms of violent irritation come on, they are ordinarily attributed to certain individual circumstances, such as extreme sensibility, or a particular disposition to spasm. Hence, it is believed, that they should be considered as exceptions, which do not exclude the general rule, and prove nothing against the utility of the operation. But, how (says Scarpa) can the surgeon ascertain the existence, or non-existence of these individual dispositions, in the children, upon which he is to operate? Assuredly, those subjects, in which I have had occasion to notice the above accidents, enjoyed, before the operation, perfect health in every respect.

"Whatever process be adopted for tying the umbilical hernia, it is evident, that the tumour can only be constricted as far as a little way on this side of the aponeurotic ring of the umbilicus, whence it follows, that the integuments must always remain prominent and relaxed for a certain extent, at the front and circumference of this opening. Also, after the separation of the strangulated portion, there necessarily remains, under the cicatrix, a portion of the hernial sac, and of the loose integuments, which covered it; and as the cicatrix itself never acquires sufficient firmness to resist the impulse of the viscera, which tend to insinuate themselves into the remains of the hernial sac, the hernia, sooner or later, reappears, and, in a short time, becomes larger, than it was before the operation. If the subject is a little girl, it may be apprehended that the first pregnancy will cause a recurrence of the hernia; for, it is known, that, during gestation, the external cicatrix of the umbilicus is considerably distended, and much disposed to give way."

Scarpa then notices, that "after the separation of the tumour, there always remains, between the aponeurotic ring of the navel, and the integuments, a small cavity, formed by the neck of the hernial sac; a cavity into which the viscera begin to insinuate themselves after the operation, so as to hinder the complete contraction of the umbilical ring. The demonstration of what I have advanced is, in some measure, to be found in the old method of operating for the inguinal hernia, not in a strangulated state, by the ligature of the hernial sac and spermatic chord. Most of the herniæ, operated upon by this barbarous process, were subject to relapses, because, in all probability, the cicatrix was not sufficiently firm to resist the impulse of the viscera, which entered the remains of the hernial sac. In the same manner, after the common operation for the strangulated inguinal hernia, although the cicatrix is formed very near the ring, there is no prudent surgeon, who does not advise the patient to wear a bandage the rest of his life; observation having proved that the hernia is still liable to recur.

"The experience of several ages leaves no doubt, that compression alone is an extremely efficacious method of radically curing the umbilical hernia of young subjects. It is attended with no risk; and, provided it be executed with the requisite caution, it is hardly ever necessary to continue it longer than two or three months for the purpose of obtaining a complete cure. On the other side, if it be clearly proved, by all that I have been observing, that the ligature never accomplishes a perfect cure without compression, it is manifest, that it cannot be at all advantageous for the children of the poor, since a bandage cannot be dispensed with. It may be said, that, in general, it does not shorten the treatment; for, in the most successful cases, the ulcer caused by it, is not healed in less than a month; and, in order to make the cure certain, an exact compression must be afterwards kept up, by means of a bandage, two months longer. It has already been stated, that three months are ordinarily sufficient for obtaining a radical cure by the mere employment of a compressive bandage." (*Scarpa, Traité des Hernes*, p. 344—349.)

M. Girard published a Memoir on the Umbilical Hernia of Children, which was read to the Medical Society of Lyons, in May 1811; and the object of which was to recommend compression as an effectual means of cure. The arguments used were very similar to those adduced by Scarpa. In the course of the discussion, M. Cartier affirmed, that he had seen many children operated upon by Desault, who were not cured of their herniæ. (See *Journ. Gén. de Méd.* t. xli. 1811.) The subject was afterwards taken up by the Medical Society of Paris, and the result of the debate was, that the employment of the ligature ought to be rejected. 1. Because the cure of umbilical herniæ is often accomplished by nature alone. 2. Because compression, either alone, or aided by tonic remedies, always succeeds. 3. Because the operation of the ligature deserves the triple reproach of being painful, and not free from danger, if unfortunately a piece of intestine should chance to be included in the ligature; of not succeeding in general, except with the assistance of compression; and of being sometimes uselessly practised, as Desault himself gives us instances of. According to M. Cayol, the insufficiency of the ligature was long since acknowledged by Sabatier, Lassus, Richerand, &c.

The treatment by compression is universally preferred by British surgeons.

Umbilical Hernia in Adult Subjects.

This case is to be treated on the principles common to all ruptures. When reducible, the parts should be kept up with a bandage, or truss; which plan, however, in grown up persons, affords no hope of a radical cure. Mr. Hey has described some very good trusses for the exomphalos, which are applicable to children, when compression is preferred, as well as to adult subjects. One was invented by the late Mr. Marrison, an ingenious mechanic at Leeds.

"It consists of two pieces of thin elastic steel, which surround the sides of the abdomen, and nearly meet behind. At their anterior extremity they form conjointly an oval ring; to one side of which is fastened a spring of steel of the form represented in the plate in Hey's work. At the end of this spring is placed the pad or bolster that presses upon the hernia. By the elasticity of this spring, the hernia is repressed in every position of the body, and is thereby retained constantly within the abdomen. A piece of calico or jean is fastened to each side of the oval ring, having a continued loop at its edge, through which a piece of tape is put, that may be tied behind the body. This contrivance helps to preserve the instrument steady in its proper situation." (*Practical Obs. in Surgery*, p. 231.) In the second edition of the preceding work, another truss for exomphalos is described; the invention of Mr. England, of Leeds.

When the exomphalos is irreducible and large, the tumour must be supported with bandages.

It is observed by Scarpa, that the umbilical hernia, and those of the linea alba, are less subject to be strangulated, than the inguinal and femoral herniæ; but that, when they are unfortunately affected with strangulation, the symptoms are more intense, and gangrene comes on more rapidly, than in every other species of rupture. If the operation be performed, the event is frequently unfavourable, because it is generally done too late. This practical fact is proved by the experience of the most celebrated surgeons of every age. "*Il est certain* (says Dionis) *que de cette opération il en périt plus qu'il n'en réchappe.*" (*Cours d'Opérations*, p. 98. ed. 1777, *avec les notes de La Faye.*) He also adds, that they who have the misfortune to be afflicted with an exomphalos should rather dispense with their shirt, than a bandage. Heister says nearly the same thing. (*Instit. Chirurg.* t. ii. cap. 94.)

When the omentum alone is strangulated in the exomphalos, or hernia of the linea alba, observation proves, that the symptoms are not less intense, than when the intestine is also incarcerated. There is this difference, however, that when the omentum alone is strangulated, only nausea occurs, and, if vomiting should likewise take place, it is less frequent and violent than when the bowel itself is strangulated. In the first case, the stools are hardly ever entirely suppressed. The proximity of the stomach is, no doubt, the reason, why the strangulation of the omentum, in the umbilical hernia, occasions far more intense symptoms of sympathetic irritation, than the strangulation of the same viscus in the inguinal, or crural hernia.

Here, the operation is not only always necessary, but urgently required. It is not materially different from that, which is practised for strangulated inguinal and crural herniæ; but, in general, it demands greater circumspection, on account of the connection, or intimate adhesions, which frequently exist between the integuments and hernial sac, and also the adhesions, which often prevail between the latter part and the omentum which it contains.

The situation of the intestine, which is frequently covered by, and enveloped in the omentum, is another circumstance deserving earnest attention. (*Scarpa, Traité des Hernies*, p. 361, 362.)

Mr. Pott is not such an advocate as Scarpa for the early performance of the operation in cases of exomphalos:—"The umbilical, like the inguinal hernia, becomes the subject of chirurgic operation, when the parts are not reducible by the hand only, and are so bound as to produce bad symptoms. But though I have, in the inguinal and scrotal herniæ, advised the early use of the knife, I cannot press it so much in this: the success of it is very rare, and I should make it the last remedy. Indeed, I am much inclined to believe, that the bad symptoms which attend these cases are most frequently owing to disorders in the intestinal canal, and not so often to a stricture made on it at the navel, as is supposed. I do not say that the latter does not sometimes happen; it certainly does; but it is often believed to be the case when it is not.

"When the operation becomes necessary, it consists in dividing the skin and hernial sac, in such manner as shall set the intestine free from stricture, and enable the surgeon to return it into the abdomen." (*Pott, On Ruptures.*)

The rest of the conduct of the surgeon is to be regulated by the usual principles.

The division of the stricture is properly recommended to be made directly upward, in the course of the linea alba.

In consequence of the great fatality of the usual operation for the exomphalos, I think the plan suggested, and successfully practised by Sir A. Cooper, in two instances, should always be adopted whenever the tumour is large, and free from gangrene; a plan, that has also received the high sanction of that distinguished anatomist and surgeon, Professor Scarpa. (*Traitè des Hernies*, p. 362.) Perhaps, I might safely add, that when the parts admit of being reduced, without laying open the sac, this method should always be preferred. It consists in making an incision just sufficient to divide the stricture, without opening the sac at all, or, at all events, no more of it than is inevitable.

In umbilical hernia, of not a large size, Sir A. Cooper recommends the following plan of operating:—"As the opening into the abdomen is placed towards the upper part of the tumour, I began the incision a little below it, that is, at the middle of the swelling, and extended it to its lowest part. I then made a second incision at the upper part of the first, and at right angles with it, so that the double incision was in the form of the letter T, the top of which crossed the middle of the tumour. The integuments being thus divided, the angles of the incision were turned down, which exposed a considerable portion of the hernial sac. This being then carefully opened, the finger was passed below the intestines to the orifice of the sac at the umbilicus, and the probe-pointed bistoury being introduced upon it, I directed it into the opening at the navel, and divided the linea alba downwards, to the requisite degree, instead of upwards, as in the former operation. When the omentum and intestine are returned, the portion of integument and sac, which is left, falls over the opening at the umbilicus, covers it, and unites to its edge, and thus lessens the risk of peritoneal inflammation, by more readily closing the wound." (*On Crural and Umbilical Hernia.*)

Less frequent Kinds of Hernia.

The *ventral hernia*, described by Celsus, is not common; it may appear at almost any point of the anterior part of the belly, but is most frequently found between the recti muscles. The portion of intestine, &c. is always contained in a sac, made by the protrusion of the peritoneum. Sir A. Cooper imputes the disease to the dilatation of the natural foramina for the transmission of vessels, to congenital deficiencies, lacerations, and wounds, of the abdominal muscles, or their tendons. In small ventral herniæ, a second fascia is found beneath the superficial one; but, in large cases, the latter is the only one covering the sac.

Herniæ in the course of the linea alba sometimes occur so near the umbilicus, that they are liable to be mistaken for true umbilical ruptures. They may take place either above, or below the navel. The first case, however, is more frequent than the second; and the following is the reason of this circumstance, according to the opinion of Scarpa:—"The upper half of the linea alba, that which extends from the ensiform cartilage to the umbilicus is naturally broader and weaker than the lower half, the recti muscle coming nearer and nearer together, as they descend from the navel to the pubes." (*Scarpa, Traité de Hernies*, p. 333.)

The hernial sac of ruptures at the upper part of the linea alba may contain a noose of intestine, and a piece of the omentum, though, in most cases, a portion of the latter membrane alone forms the contents. In some subjects, the linea alba is so disposed to give way, that several herniæ are observed to be formed successively in the interspace between the ensiform cartilage and the umbilicus.

M. Jules Cloquet has recorded a case of ventral hernia, reaching from the ensiform cartilage to the pubes. The skin, covering it, was so thin, that the convolutions of the bowels were plainly visible. The cicatrix of the navel was perceptible rather towards the left side of the swelling. (See *Pathologie, Chir.* p. 102.)

"With respect to the small hernia (says Scarpa) which is considered as formed by the stomach, and concerning which Hoin and Garengeot have written so much (without either of them having related, at least to my knowledge, a single example proved by dissection), it is at least unproved, that it was exclusively formed by this viscus. I do not see, why the other viscera, particularly the omentum and transverse colon, might not also contribute to it. In my judgment, it only differs from other herniæ of the linea alba, in being situated on the left side of the ensiform cartilage, a situation that must materially influence the symptoms of the case. In fact, whatever may be the viscera, which form it, a sympathetic irritation of the stomach is occasioned, that is much more intense, than that which ordinarily accompanies unbilical herniæ, those of the lower part of the linea alba, or, in short, all other herniæ, which are more remote from the stomach." (*Op. cit.* p. 334.)

The following are the circumstances, by which the umbilical hernia, and that which occurs in the linea alba near the navel, may be discriminated.

The first, whether in the infant, or the adult, has a roundish neck, or pedicle, at the circumference of which, the aponeurotic edge of the umbilical ring can be felt. Whatever may be its size, its body always retains nearly a spherical shape. Neither at its apex, nor its sides, is any wrinkling of the skin, or any thing like the cicatrix of the navel, distinguishable. At some points of the surface of the tumour, the skin is merely somewhat paler and thinner, than elsewhere.

On the contrary, the hernia of the linea alba has a neck, or pedicle, of an oval form, like the fissure, through which it is protruded. The body of the tumour is also constantly oval. If the finger be pressed deeply round its neck, the edges of the opening in the linea alba can be felt; and, if the hernia be situated very near the umbilical ring, the cicatrix of the navel may be observed upon one side of it, which cicatrix retains its rugosity and all its natural appearance; a certain indication, that the viscera are not protruded through the umbilical ring. (*Scarpa, Traité des Hernies,* p. 336.)

The distinction, which Scarpa has established between the umbilical hernia, properly so called, and those of the linea alba, is not useless in regard to practice. Indeed, when the latter are left to themselves, they make much slower progress than the former. On account of their smallness, they frequently escape notice, particularly in fat persons, and when situated at the side of the ensiform cartilage. They occasion, however, complaints of the stomach, habitual colics, especially after meals; and, unfortunately for the patient, he may be tormented a very long time by these indispositions, before the true cause of them is discovered.

The umbilical hernia may be known from the earliest period of its formation, by the alteration, which it produces in the cicatrix of the navel, and the rapidity of its increase.

In other respects, these two kinds of herniæ demand the same means of cure; but those of the linea alba, *cæteris paribus,* are more difficult to cure, than ruptures at the umbilicus. This is probably owing to the natural tendency, which the umbilical ring has to close, when the hernia is kept well reduced, whilst accidental openings in the linea alba have not the same advantage. (*Scarpa,* p. 340.)

When a common ventral hernia has been reduced, should be kept in its place by means of a bandage or truss. When strangulated, it admits, more frequently, than most other cases, of being relieved by medical treatment. If attended with stricture, which cannot otherwise be relieved, that stricture must be carefully divided. Sir A. Cooper recommends the valvular incision, and the dilatation to be made, either upward or downward, according to the relative situation of the tumour and epigastric artery, which crosses the lower part of the linea semilunaris.

Pudendal Hernia.—This is the name assigned by Sir A. Cooper to the hernia, which descends between the vagina and ramus ischii, and forms an oblong tumour in the labium, capable of being traced within the pelvis, as far as the os uteri. He thinks, that this case has sometimes been mistaken for a hernia of the foramen ovale. When reducible, a common female bandage, or the truss used for a prolapsus ani, should be worn. A pessary, unless very large, could not well keep the parts from descending, as the protrusion happens so far from the vagina. Sir A. Cooper is of opinion, that, when strangulated, this hernia, in consequence of the yielding nature of the parts, may generally be reduced, by pressing them, with gentle and regular force, against the inner side of the branch of the ischium. If not, the warm bath, bleeding, and tobacco clysters, are advised. Were an operation indispensable, the incision should be made in the labium, the lower part of the sac carefully opened, and with a concealed bistoury, directed by the finger, in the vagina, the stricture should be cut directly inward, towards the vagina. The bladder should be emptied, both before the manual attempts at reduction and the operation. (*On Crural Hernia, &c.* p. 64.)

Vaginal Hernia.—A tumour occurs within the os externum. It is elastic, but not painful. When compressed, it readily recedes; but is reproduced by coughing, or even without it, when the pressure is removed. The inconveniences produced are an inability to undergo much exercise or exertion; for, every effort of this sort brings on a sense of bearing down. The vaginal hernia protrudes in the space, left between the uterus and rectum. This space is bounded below by the peritoneum, which membrane is forced downwards towards the perineum; but, being unable to protrude further in that direction, is pushed towards the back part of the vagina. In one case, Sir A. Cooper advised the use of a pessary; but the plan was neglected. Probably, these cases are always intestinal.

Some herniæ protrude at the anterior part of the vagina. (*Sir A. Cooper, On Crural Hernia,* p. 65, 66.)

Perineal Hernia.—In men, the parts protrude between the bladder and rectum; in women, between the rectum and vagina. The hernia does not project, so as to form an external tumour; and, in men, its existence can only be distinguished by examination in the rectum. In women, it may be detected both from this part and the vagina.

In case of strangulation, perhaps this hernia might be reduced by pressure from within the rectum. An interesting case of perineal hernia, which took place from the peritoneum being wounded with the gorget in lithotomy, is related by Mr. Bromfield. (*Chirurgical Obs.* p. 264.)

The reducible perineal hernia in women may be kept from descending, by means of a large pessary. Both this kind of rupture and the vaginal may prove very dangerous in cases of pregnancy. (See *Smellie's Midwifery,* case 5.)

Sacro-rectal Hernia.—In a young infant, where the ossification of the sacrum was incomplete, a protrusion is said to have been met with through an opening in that bone. The possibility of such a case should be remembered, in order that the disease may not be mistaken for spina bifida. (See *Journ. of Foreign Med.* No. 16. p. 616.)

Thyroid Hernia, or *Hernia Foraminis Ovale.*—In the anterior and upper part of the obturator ligament, there is an opening, through which the obturator artery, vein, and nerve proceed, and through which, occasionally, a piece of omentum, or intestine, is protruded, covered by a part of the peritoneum, which constitutes the hernial sac.

In the case, which Sir A. Cooper met with, the hernia descended above the obturatores muscles. The os pubis was in front of the neck of the sac; three-fourths of it were surrounded by the obturator ligament; and the fundus of the sac lay beneath the pectineus and adductor brevis muscles. The obturator nerve and artery were situated behind the neck of the sac, a little towards its inner side. This species of hernia can only form an outward tumour, when very large. Garengeot, however, met with an instance, in which there was not only a swelling, but one attended with symptoms of strangulation: he reduced the hernia, which went up with a guggling noise; the symptoms were stopped, and stools soon followed.

M. Jules Cloquet gives the particulars of a thyroid hernia, met with in the dead body of a woman, aged about fifty. It formed a slight roundish tumour in the lower part of the left groin; and the skin over it was of a purple colour. On opening the abdomen, all the upper portion of the small intestines was inflamed, and enormously distended with liquid feces and gas. A noose of the bowel, which was strangulated in the thyroid foramen, had given way at two points just above the stricture, and the intestinal matter had escaped freely into the cavity of the peritoneum. A piece of omentum also protruded at the upper part of the thyroid foramen, together with the intestine. On dissection, M. Cloquet found the hernia covered successively by the skin and superficial fascia; the fascia lata; and the middle adductor and pectineus muscles, which were raised up by the protrusion which had passed between the fibres of the adductor brevis. There were two saphenal veins, which, as well as the crural vessels, were somewhat displaced outwards by the tumour. The tumour was oblong, with an oblique direction, from above inwards, and it was divided by a constriction into two portions; the larger above, the smaller below. The upper portion ascended towards the spine of the pubes, in front of the obturator externus, and behind some fibres of the adductor brevis. This part of the sac was higher up, than the opening by which the hernia had escaped. The obturator vessels and nerve, and the hypogastric vein, lay to the outer side and behind the neck of the sac, below which the artery divided into two branches. The lower of these passed behind the sac to be distributed to the obturator externus, and adductor brevis; while the other passed also behind the sac, and then turning round its inner side, on a level with the neck, proceeded in front of it to the pectineus. The sac rested posteriorly on the obturator externus muscle, which it had separated from the ligament. (See *Jules Cloquet, Pathologie, Chir*. p. 107.)

The hernia of the foramen ovale, when reducible, must be kept up with a suitable truss; and if it were strangulated, and not capable of relief from the usual means, an operation would be requisite, though attended with difficulties. The division of the obturator ligament and mouth of the sac should be made inwards, to avoid the obturator artery. If this vessel, however, were to arise in common with the epigastric artery, it would be exposed to injury by following this plan. (See *Garengeot in Mém. de l'Acad. de Chir*. t. i. *Sir A. Cooper, On Crural Hernia, &c.* p. 70.)

Cystocele. — As Mr. Pott observes, "The urinary bladder is also liable to be thrust forth from its proper situation, either through the opening in the oblique muscle, like the inguinal hernia, or under Poupart's ligament, in the same manner as the femoral.

"This is not a very frequent species of hernia, but does happen, and has as plain and determined a character as any other.

"It has been mentioned by Bartholin, T. Dom. Sala, Platerus, Bonetus, Ruysch, Petit, Mery, Verdier, &c. In one of the histories given by the latter, the urachus, and impervious umbilical artery on the left side, were drawn through the tendon into the scrotum, with the bladder; in another, he found four calculi.

"Ruysch gives an account of one complicated with a mortified bubonocele. Petit says, he felt several calculi in one, which were afterwards discharged through the urethra. (See also *J. G. F. John de insolitâ Calculi Ingentis per Scrotum Exclusione.* Wittenburg, 1750.)

"Bartholin speaks of T. Dom. Sala as the first discoverer of the disease, and quotes a case from him, in which the patient had all the symptoms of a stone in his bladder: the stone could never be felt by the *sound*, but was found in the bladder (which had passed into the groin) after death." (*Pott.*)

According to Sir Astley Cooper, the increase or diminution of the size of the tumour is not much affected by the position of the patient's body, but depends more upon the accumulation, or evacuation of urine. "This variation of size, however, is not always observable, as the bladder does not always discharge the whole of its contents, when the patient makes water; that part of the viscus within the pelvis completely emptying itself, while the portion within the scrotum remains distended, as before the attempt to void the urine. Persons, therefore, labouring under this complaint are sometimes under the necessity of raising the scrotum, and pressing upon it, in order to force its contents into the pelvic portion of the bladder, by which means the whole volume of water is discharged by the urethra." Another troublesome symptom is frequent desire to make water, caused by its imperfect evacuation. The fluctuation might lead to a suspicion of hydrocele; but, in the two cases, seen by Sir Astley Cooper, there was no transparency. (*On Hernia*, part ii. p. 63.)

This circumstance, together with the return of the urine into the bladder in the pelvis, and the consequent desire to make water, or the tumour being compressed, will prevent such a mistake. But Bertrand met with a case, in which such recession of the urine could not be made to take place by pressure. Verdier gives a case, in which a calculus in the protruded part of the bladder, was mistaken for a bubo, and caustic was applied, by which an urinary fistulous opening was produced.

As the bladder is only covered in part by the peritoneum, the hernia cystica has no sac; and when complicated with a bubonocele, that portion of the bladder which forms the cystic hernia lies between the intestinal hernia and the spermatic chord — that is, the intestinal hernia must be anterior to the cystic.

The vesical hernia is believed by Sir Astley Cooper to have its origin in a relaxed state of the bladder, and he suspects, that the protrusion may also be promoted by neglect to empty the bladder at the time required. The bladder thus becomes distended laterally; and then reaches the superior opening of the inguinal canal, through which it is forced by the pressure of the superincumbent viscera, and the action of the diaphragm and abdominal muscles. "As the anterior and lateral parts of the bladder are, in some degree, devoid of peritoneal covering, the bladder at first enters the inguinal canal, without bringing that membrane with it; but, as soon as the fundus begins to descend, the peritoneum accompanies it; and with the sac, thus formed, intestine and omentum afterwards protrude." (See *Sir A. Cooper, On Hernia*, part ii. p. 64. ed. 2.)

While recent, this kind of hernia is reducible, and should be kept up with a truss. When it is of any date, or has arrived to any considerable size, as Pott remarks, the urine cannot be discharged, without lifting up, and compressing the scrotum: the outer surface of the bladder is now become adherent to the cellular membrane, and the patient must be contented with a suspensory bag.

"In case of complication with a bubonocele, if the operation becomes necessary, great care must be taken not to open the bladder instead of the sac, to which it will always be found to be posterior."

Verdier and Sharp, have accurately described the cystocele. Pott has recorded two cases, which fell under his observation. (Vol. iii.) Pipelet mentions a cystic hernia in perinæo; and several cases of its occurrence in the female. (*Acad. de Chir.* t. 4.) Pott cut into one cystocele by mistake. Mention is made (*Edin. Surg. Journ.* vol. iv. p. 512.) of a cystic hernia, which protruded between the origins of the levator ani, and obturator internus muscles: the tumour made its appearance in the pudendum of an old woman. A similar case is published in Sir Astley Cooper's work, as communicated to him, by Mr. Burns, of Glasgow. Sir Astley has also recorded the particulars of the dissection of two inguinal cystoceles.

An instance of protrusion of the bladder through a wound, caused by a bullock's horn, is recorded by Larrey. (*Mém. de Chir. Mil.* t. 4. p. 289.)

Ischiatic Hernia.—This disease is very rare. A case, however, which was strangulated, and undiscovered till after death, is related in Sir A. Cooper's second part of his work on hernia. It was communicated by Dr. Jones, so celebrated for his book on hemorrhage. The disease happened in a young man, aged 27. On opening the abdomen, the ileum was found to have descended on the right side of the rectum into the pelvis, and a fold of it was protruded into a small sac, which passed out of the pelvis at the ischiatic notch. The intestine was adherent to the sac at two points: the strangulated part, and about three inches on each side, were very black. The intestines towards the stomach were much distended with air, and here and there had a livid spot on them. A dark spot was even found on the stomach itself, just above the pylorus. The colon was exceedingly contracted, as far as its sigmoid flexure. A small orifice was found in the side of the pelvis, in front of, but a little above, the sciatic nerve, and on the forepart of the pyriformis muscle. The sac lay under the glutæus maximus muscle, and its orifice was before the internal iliac artery, below the obturator artery, but above the vein. Sir A. Cooper remarks, that a reducible case might be kept up with a spring-truss, and, that if an operation were requisite, the orifice of the sac should be dilated directly forwards. (*On Crural Hernia, &c.* p. 73.)

Phrenic Hernia.—The abdominal viscera are occasionally protruded through the diaphragm, either through some of the natural apertures in this muscle, or deficiencies, or wounds, and lacerations in it. The second kind of case is the most frequent:—Morgagni furnishes an instance of the first. Two cases, related by Dr. Macauley, in *Med. Obs. and Inq.* vol. i.; two more detailed in the *Medical Records, and Researches;* and two others published by Sir A. Cooper, are instances of the second sort: and another case has been lately recorded by the latter gentleman, affording an example of the third kind. A laceration of the diaphragm by fractured ribs, has produced a hernia. A case of this kind was dissected by Mr. Travers, at Guy's Hospital. (*Med. Chir. Trans.* vol. vi. p. 375.) In this last volume may also be found the particulars of an interesting example, in which a considerable part of the large curvature of the stomach was protruded through a fissure of the diaphragm. The accident was unattended with any fracture of the ribs, and was caused by the upsetting of a stage-coach, on which the patient was an outside passenger. Before death, he vomited up a large quantity of blood, and a small semicircular aperture was discovered on dissection in the lower part of the strangulated portion of the stomach. (P. 378, 379.) See also *B. Stehelin, Tentamen, Med. quod ventriculum, qui in thoracem migraverat, &c. describit*, 1721 (*in Halleri Disp. Anat.* tom. vi. p. 675.) Hildanus, Paré, Petit, Schenck, &c., also mention cases of phrenic hernia. The disease is quite out of the reach of art.

Mesenteric Hernia.—If one of the layers of the mesentery be torn by a blow, while the other remains in its natural state, the intestines may insinuate themselves into the aperture, and form a kind of hernia. The same consequence may result from a natural deficiency in one of these layers. Sir A. Cooper records a case, in which all the small intestines, except the duodenum, were thus circumstanced. The symptoms during life were unknown. (*On Crural Hernia, &c.*, p. 82.)

Mesocolic Hernia.—So named by Sir Astley Cooper, when the bowels glide between the layers of the mesocolon. A specimen of this disease is preserved at St. Thomas's Hospital.

Every surgeon should be aware, that the intestines may be strangulated within the abdomen from the following causes:—1. Apertures in the omentum, mesentery, or mesocolon, through which the intestine protrudes. 2. Adhesions, leaving an aperture, in which a piece of intestine becomes confined. 3. Membranous bands at the mouths of hernial sacs, which becoming elongated, by the frequent protrusion and return of the viscera, surround the intestine, so as to strangulate them within the abdomen, when returned from the sac. (See *Sir A. Cooper, On Crural Hernia, &c.* p. 85.)

Pott remarks, that "Ruysch gives an account of an impregnated uterus being found on the outside of the abdominal opening; and so do Hildanus and Sennertus. Ruysch also gives an account of an entire spleen having passed the tendon of the oblique muscle. And I have myself seen the ovaria removed by incision, after they had been some months in the groin." (Vol. ii.)

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HERNIA CEREBRI. (*Fungus Cerebri. Encephalocele.*) There are two principal kinds of hernia cerebri: one presents itself in young infants, before the ossification of the skull is completed; the other takes place after the destruction of a part of the skull by the operation of the trephine, accidental violence, or disease.

The congenital hernia cerebri of infants occurs, however, in two very different forms: in one, it is covered by the scalp; in the other, the corresponding integuments of the head, and sometimes even the dura mater, are deficient.

The common encephalocele, met with in new-born children, seems to originate from the imperfect ossification of the skull, especially in the situation of the fontanella, and sutures. This case is characterised by a soft swelling, of an equal round shape, which is attended with a pulsation corresponding with that of the pulse: it yields and disappears under pressure, offers no alteration in the colour of the skin, and is circumscribed by the margin of the defective portion of the skull. (*Ferrand, in Mém. de l'Acad. de Chir.* t. xiii. in 12mo. p. 102.) In general, the mental faculties are not affected; and we read of one example, in which a patient had such a hernia cerebri thirty-three years, without his intellects ever having been impaired during the whole of that period. (*Op.* cit. t. v. in 4to. p. 863.)

It is tolerably well established, that the congenital hernia cerebri, which arises from the incomplete ossification of the skull, and is covered by the scalp, ought to be treated by the application of constant, yet moderate, pressure. M. Salleneuve communicated to the Royal Academy of Surgery in France an example of the good effects of this treatment, which reduces the size of the tumour, and accomplishes a perfect cure as soon as the ossification is completed. M. Salleneuve put a piece of thin sheet lead, properly covered with soft linen, under the child's cap, to which it was sewed in a suitable situation, and the degree of pressure was increased, or lessened, according as circumstances required, by tightening or loosening the cap. (*Op.* cit. p. 103. t. xiii. ed. 12mo.)

The experience of Callisen also confirms the fact that hernia cerebri, when of moderate size, may be cured by the foregoing method, the aperture becoming gradually closed. But he adds, that large tumours of this description, especially when situated about the occiput, scarcely admit of any means of relief, except the employment of some contrivance to protect them from external injury. (*System. Chir. Hodiernæ,* vol. ii. p. 513, 514. ed. 1800.)

When the ossification of the sutures in children is late, the cerebellum, as well as the cerebrum, is liable to protrusion. In 1813, two such cases occurred at Paris. In one, Professor Lallement mistook the disease for a common tumour, and commenced an operation for its removal, when, after making some of the necessary incisions, his proceedings were stopped by his seeing the white silvery colour of the dura mater, and that the swelling came out of an aperture in the occipital bone. The day after the operation the child was seized with violent pain in the head, had a hard pulse, prostration of strength, vomiting, &c., and died in the course of a week. On dissection, a part of the tentorium, and an elongation of the two lobes of the cerebellum, about as large as a nut, were found in the protruded sac of the dura mater. Several abscesses were also discovered in the substance of the cerebellum. The other example fell under the observation of M. Baffos: upon the death of the child, the dissection evinced similar appearances. (*Richerand, Nosographie Chir.* t. ii. p. 319. ed. 4.)

Such facts should teach the surgeon to be particularly cautious in ascertaining the nature of tumours about the back part of the head, before he ventures to attempt their removal.

The second kind of congenital encephalocele is that, in which not only large portions of the cranium, but also more or less of the integuments of the head, are deficient. It is rather to be regarded as a malformation, than a disease; and, indeed, in most instances, the infants are still-born. The case sometimes consists of the protrusion of most of the brain through the inferior and posterior fontanellæ, so that the child is born with a largish bag, on the back of its head, hanging down over the posterior part of the neck. Several specimens of these malformations, taken from infants born in the Hospice de la Maternité, are preserved in the museum of the Faculté de Médecine at Paris. (*Richerand, Nosogr. Chir.* t. ii. p. 316. ed. 4.) In the year 1810, a remarkable case of this last description of congenital hernia cerebri was published by Dr. Burrows. "The whole of the forehead, summit, and a great part of the occiput, were deficient; and in lieu of them a substance projected of a light mulberry colour, and of the mushroom form, except that it was proportionably broader. From the deficiency of bone, the eyes appeared to project much more than usual. The child lived six days without either taking sustenance, or having any evacuation." On dissection, the scalp, the os frontis, the parietal, and a great part of the occipital bones, were wanting. Through the parts, at which these bones were deficient, the cerebrum projected, exhibiting its usual convolutions. It was covered with the pia mater; was of a mulberry colour; appeared to be more vascular, than the pia mater usually is; and the edge of the scalp adhered to the neck of the tumour. The cerebellum was not more than one-fourth of its usual size; for, the posterior part of the os occipitis was much nearer to the sella turcica, than natural. The child was destitute of the power of voluntary motion, and all the secretions appeared to be stopped. (See *Med. Chir. Trans.* vol. ii. p. 52.)

The most interesting species of hernia cerebri to the practitioner, is that which sometimes arises after the removal of a portion of the skull by the trephine, or the destruction of part of it by disease. Numerous examples of this disease are recorded; and I have myself seen several instances of it. Although the case has attracted considerable notice, modern surgeons are far from entertaining settled opinions, concerning the exact nature of the tumour.

In one example, recorded by Abernethy, the hernia cerebri arose on the tenth day after trephining, and was as large as a pigeon's egg. The pia mater, covering it, was inflamed; and a turbid serum was discharged at the sides of the swelling, from beneath the dura mater. On the eleventh day, the tumour was as large as a hen's egg, smooth, and ready to burst. The man died the next day. On examination, the swelling was found still larger, and of a dark colour, with an irregular granulated surface. This appearance was owing to coagulated blood, which adhered to its surface, as the part had bled so much, that the patient's cap was rendered quite stiff with blood. The pia mater was in general much inflamed, and, as well as the dura mater, was deficient at the place of the tumour. The deeper part of the swelling seemed to consist of fibrous coagulated blood, and it was found to originate about an inch below the surface of the brain.

Mr. Abernethy explains the formation of the disease as follows:—"In consequence of the brain being injured to some depth beneath the surface, disease of the vessels, and consequent effusion of the blood had ensued: the effusion was, for a time, restrained by the superincumbent brain and its membranes; but, these gradually yielding to the expansive force exerted from within, and at last giving way altogether, the fluid blood oozed out and congealed upon the surface of the tumour." An organised fungus can hardly be produced so rapidly as these tumours are formed. (*On Injuries of the Head, in Surgical Works,* vol. ii. p. 53.)

On the contrary, Sir C. Bell declares, that the swelling is vascular and organised. (*Operative Surgery,* vol. i.) Dr. John Thomson also entertains a different opinion from that of Abernethy, respecting the mode in which these herniæ cerebri are formed; but, I question whether he may not have confounded with the disease now under consideration, fungous tumours of the dura mater. At least, some of the cases, to which he alludes, as a reason for his sentiment concerning their mode of formation, must have been the disease so well described by M. Louis. (See DURA MATER.) The reader, however, must judge for himself from the following passage:—"In a considerable number of those who had the cranium severely contused, or fractured by musket-balls (says Dr. Thomson), fungous growths took place through the openings, which had been made at first by the ball, or afterwards by the trepan. These growths, I am inclined to believe, are the consequence of a contusion of the substance of the brain, and of the membranes that cover it, which gives rise to the formation of a new, organised substance, different in its texture from brain; and are not, as some late writers would endeavour to persuade us, simply protrusions of the brain, resulting from the removal of the natural resistance, which is made to them by the dura mater and cranium. *I have known instances of substances, similar to these growths, forming on the surface of the brain, immediately under the place where the cranium had received a contusion, in cases in which the trepan had not been applied, or any portion of the cranium removed.*

"Fungus of the brain, in the greater number of instances, in which we had an opportunity of observing it, was accompanied either with stupor or paralysis, and other symptoms of compressed brain. In a fracture of the vertex of the cranium, produced by a musket-ball, and followed by a fungus of the brain, the paralysis took place in the lower extremities. In a case of wound, made by a musket-ball on the right side of the forehead, and in which spiculæ of bone had been driven in upon the brain, a large fungus protruded. The formation of this fungus was followed by slow pulse, stupor, dilated pupils, slight strabismus, and distortion of the mouth. In the progress of this case, escharotics were applied to the fungus, portions of it were torn off by the patient, and all of it that was exterior to the cranium was twice pared off by the knife, with an apparent alleviation, rather than aggravation, of the symptoms. On the death of this patient, nearly the whole of the right hemisphere of the brain was found converted into a soft pulpy mass. The left hemisphere was not changed in structure, though much vascular turgescence appeared on its surface." (See *Dr. J. Thomson's Report of Obs. made in the Military Hospitals in Belgium,* p. 57, 58.)

From the investigations of Mr. Stanley, the fact is placed beyond all doubt, that a part of the brain occasionally constitutes the substance of herniæ cerebri; and he thus confirms the opinion formerly entertained upon this point by Quesnay and Louis. Thus, in the first case which Mr. Stanley has recorded, "the whole tumour was sliced off with a scalpel. During the operation, the boy gave no manifestation of positive pain, although not unconscious of what we were doing. Considerable hemorrhage took place from the surface of the brain, exposed by the removal of the tumour, the blood being thrown with great force, and to a considerable distance, from numerous vessels, which were attempted to be secured, but ineffectually, by ligatures. After a short time, however, the bleeding ceased. On examination of the part, which had been cut off, its exterior was found to consist merely of a layer of the coagulated blood: the rest of the mass was brain, possessing a natural appearance, the distinction between the cortical and medullary matter being readily seen, with the convolutions and pia mater dipping down between them." In the dissection after death, "all that part of the dura mater, adjacent to the ulcerated aperture, through which the brain had protruded, was black, sloughy, and much thickened. The exposed surface of the brain, from which the portion had been cut off, exhibited a softened and broken-down texture; a state of disorganisation, which extended deep into its substance. About an ounce of fetid and dark-coloured fluid was found between the dura mater and arachnoid membrane. Several small effusions of blood were met with, both between the membranes and in the substance of the brain. The arachnoid membrane was thickened and opaque over each hemisphere. The vessels on the surface, and in the substance of the brain, were remarkably free from blood. The lateral ventricles were large, and filled with transparent fluid, and there was some found between the membranes at the basis, so that, altogether, the quantity from these two sources was very considerable." (See *Med. Chir. Trans.* vol. viii. p. 15—17.) In another dissection, a considerable quantity of pus was found on the arachnoid membrane, on each side of the falx. (P. 27.) In most of the cases of hernia cerebri, which I have seen, the patient was at first more or less sensible, but labouring under severe nervous agitation. The stupor, paralysis, and other symptoms of compressed brain, noticed by Dr. J. Thomson, did not take place, till the latter stage of the disease, and then convulsive twitches of the muscles and strabismus occasionally came on. (See *Med. Chir. Trans.* p. 26.) The disease is usually attended with great frequency of the pulse.

With regard to the cause of the protrusion, it is a subject very difficult of explanation, because if the origin of the tumour depended simply on the removal of a portion of the skull, or on any changes of the dimensions of the brain in expiration, the effect would always follow such causes, and prevail in all patients. From the particulars of the dissections, performed by Mr. Abernethy and Mr. Stanley, and those referred to by Dr. J. Thomson, it is clear that hernia cerebri is a disease connected with deep-seated changes throughout a great part of the brain. (See also *Larrey, Mém. de Chir. Mal.* t. iv. p. 206.) The substance of this organ is found more or less pulpy and disorganised; and after death, large effusions of serum, and even sometimes of blood, and purulent matter are observed. These appearances leave no doubt of the disease being associated with inflammatory action within the head. It is highly probable, therefore, that a hernia cerebri is only produced when these deep-seated changes are conjoined with the removal of bone. The changes alluded to may be supposed to cause an increase in the general contents of the skull, and thus a disposition to protrusion, as rapid as the serum and other fluids are effused. This statement, however, can only be received as an hypothesis, because we find, that in one of the dissections, described by Mr. Stanley, "there existed a considerable space between the upper surface of the right hemisphere, all around the situation of the protrusion, and the internal surface of the dura mater, while, in every other part, the brain and dura mater were in close contact." (See *Med. Chir. Trans.* vol. viii. p. 27.) Now, the idea of an empty space within the cranium is rather inconsistent with the supposition that the brain is thrust out, in consequence of changes which augment the quantity of the general contents of the skull, unless such space were filled with air, that had no external communication.

When the bad symptoms disappear, on the tumour being no longer confined by the dura mater, some practitioners deem it best to interfere as little as possible, and let the tumour drop off in pieces. (See *Edinb. Med. Comment.* vol. i. p. 98. *Med. Museum*, vol. iv. p. 463.) The mildest dressings are to be employed; but whether the protrusion should be resisted by pressure or not, seems unsettled.

When the tumour acquires considerable size, it may be pared off with a knife, as was done by Mr. Hill, in several instances, with success. (*Cases in Surgery*, 8vo. Edinb. 1772.)

In one of the cases, published by Mr. Stanley, the patient, a boy about eleven years of age, recovered after the upper part of the tumour had been pared off, and some of the removed substance was found to consist decidedly both of cortical and medullary substance. In this instance, the reproduction of the tumour was checked by firm pressure with graduated compresses, and a bandage. The protruded brain gradually lost its natural colour: it acquired a light yellow appearance, was split into several portions, and a very fetid odour exhaled from it. Its substance daily became softer, ultimately acquiring almost a semi-fluid state, and in this condition, the whole mass gradually wasted away. *Fresh granulations arose to fill up the vacancy, and they were manifestly produced from the exposed substance of the brain.* Compression being continued, the part now quickly healed up. (See *Med. Chir. Trans.* p. 20, 21.) In a third case, the part of the tumour cut off consisted entirely of cortical and medullary substance, quite healthy in its appearance (p. 24); and subsequently granulations were formed from the exposed surface of the brain. The case, however, had a fatal termination. By the removal of the swelling, and the use of compression, one cure was effected by Mr. Pring. (See *Edin. Med. and Surgical Journ.* vol. ix.)

Richerand affirms, indeed, generally, that when the brain is exposed, in consequence of an injury of the head, the encephalocele should be cut down with a knife, and repressed by gentle compression. (See *Nosogr. Chir.* t. ii. p. 318. ed. 4.)

Sir A. Cooper is also an advocate for pressure, made with adhesive plaster; and a compress of lint wet with liquor calcis: his aim is to reduce the swelling to a level with the bone, when, he says, the scalp will heal over it. (*Lectures*, vol. i. p. 317.)

The cases published by Mr. Stanley are rather favourable to the employment of pressure, inasmuch as it appeared evidently to check the protrusion, and was mostly borne without inconvenience. The idea, however, that when the brain protrudes through the dura mater, pressure can effect its return, is, as Mr. Stanley judiciously observes, quite untenable. (*Med. Chir. Trans.* vol. viii. p. 36.)

Quesnay mentions an instance in which a patient tore off the protruded mass himself, and the cavity healed up. (*Mém. de l'Acad. de Chir.* t. i.) Van Swieten relates a case, in which the swelling was repeatedly removed with a ligature, and a cure ensued. (*Comment.* t. i. p. 440.) The danger of applying styptics, and irritating applications, is shown by Hildanus, obs. 14., and Mr. Hill, p. 198.

Baron Larrey considers the treatment by excision, pressure, and, spirituous applications, hurtful and dangerous: his advice is merely to apply to the swelling a pledget of slightly camphorated oil of camomile; to have recourse to cooling aperient beverages; to remove all kinds of irritation; to exclude the air; and apply the dressings with great gentleness. By these means, the only case which Larrey ever saw recover, was saved; and in it the tumour was small. (*Mém. de Chir. Mil.* t. iv. p. 206.)

Quesnay sur la Multiplicité des Trépans, in Mém. de l'Acad. Royale de Chirurgie, t. ii. p. 25. 56. ed. in 12mo. *M. Corvin*'s Dissert. in Haller's Disputat. Chir. vol. ii. Mém. sur l'Encephalocele, par *M. Ferrand*, in Mém. de l'Acad. de Chir. t. xiii. p. 96. edit. 12mo. *Lassus*, Pathologie Chir. t. ii. p. 140. edit. 1809. *Abernethy*'s Essay on Injuries of the Head. *Hill*'s Cases in Surgery. *Burrows*, in Med. Chir. Trans. vol. ii. *Callisen*, Systema Chirurgiæ Hodiernæ, vol. ii. p. 512. edit. 1800. *Sir C. Bell*'s Operative Surgery, vol. i. *Richter*'s Anfangsgründe der Wundarzneykunst, b. ii. p. 197. ed. 1802. *Richerand*, Nosographie Chir. t. ii. p. 316. ed. 4. Paris, 1815. *D. J. Thomson*'s Report of Observations made in the Military Hospitals in Belgium, p. 57. Edinb. 1816. *Delpech*, Précis Élémentaire des Maladies Chir. t. ii. p. 447, et seq. Paris, 1816. *Crell* and *Sand*, in Haller's Disput. Chir. t. i. *E. Stanley*, in Med. Chir. Trans. vol. viii.; a paper, containing many valuable observations. *M. le Baron Larrey*, in Mém. de Chir. Mil. t. iv. p. 203, &c. *Hennen*'s Military Surgery. p. 311. &c. edit. 2. *A. Solomons*, De Cérebri Tumoribus, Edinb. 1810. *J. C. Schoenlen* von der Hirnmetamorphose, 8vo. Würzb. 1816.

HERNIA HUMORALIS. *Orchitis.* Inflammation of the testicle, especially when produced by irritation in the urethra, gonorrhœa, the use of bougies, &c. As the term is founded upon the exploded doctrine of the translation of humours, from one part to another, the sooner its employment is abandoned the better. The case is considered under the word *Testicle*.

HERPES. (from ἕρπω, to creep.) Nothing could be more confused and undefined, than the idea conveyed by the term *herpes*, as generally employed until a few years ago, when the judicious distinctions, proposed by the late Dr. Willan, began to have due influence. The appellation, *herpes*, is limited "to a vesicular disease, which, in most of its forms, passes through a regular course of increase, maturation, and decline, and terminates in about ten, twelve, or fourteen days. The vesicles arise in distinct, but irregular clusters, which commonly appear in quick succession, and they are set near together, upon an inflamed base, which extends a little way beyond the margin of each cluster. The eruption is preceded, when it is extensive, by considerable constitutional disorder, and is accompanied with a sensation of heat and tingling, sometimes with severe deep-seated pain, in the parts affected. The lymph of the vesicles, which is at first clear and colourless, becomes gradually milky and opaque, and ultimately concretes into scabs; but, in some cases, a copious discharge of it takes place, and tedious ulcerations ensue. The disorder is not contagious in any of its forms." (See *Bateman's Practical Synopsis of Cutaneous Diseases*, p. 221, 222. edit. 3.) This author notices six species of the complaint: viz. herpes phlyctænodes; herpes zoster; herpes circinatus; herpes labialis; herpes præputialis; and herpes iris.

As most of these cases more properly belong to the physician, than surgeon, I shall briefly describe three of them.

According to Dr. Bateman, the *herpes zoster*, or *shingles*, is mostly preceded, for two or three days, by languor, and loss of appetite, rigors, headach, sickness, and a frequent pulse, together with a scalding heat, and tingling in the skin, and shooting pains through the chest and epigastrium. Sometimes, however, the precursory febrile symptoms are very slight. Upon some part of the trunk, several red patches occur, of an irregular form, at a little distance from each other, upon each of which numerous small elevations appear clustered together. These, if examined minutely, are found to be distinctly vesicular; and in the course of twenty-four hours, they enlarge to the size of small pearls, and are perfectly transparent, being filled with a limpid fluid. For three or four days, fresh clusters continue to arise, always extending themselves nearly in a line with the first, towards the spine at one end, and towards the linea alba at the other. While the new clusters are appearing, the vesicles of the first lose their transparency, and, on the fourth day, acquire a milky, or yellowish hue, which is soon followed by a bluish, or livid colour, of the basis of the vesicles, and of the contained fluid. They now become somewhat confluent and flatten, or subside. About this time they frequently break and discharge, for three or four days a serous fluid, which at length concretes into thin dark scabs. These fall off about the twelfth or fourteenth day, leaving the surface of the subjacent skin in a red and tender state; and when the ulceration and discharge have been considerable, numerous cicatrices, or pits, are left. All the clusters go through a similar series of changes.

Young persons, from the age of twelve to twenty-five, are most frequently affected; although aged persons are not altogether exempt from the complaint, and suffer severely from the pain of it. Summer and autumn are the seasons, in which it is most common. Sometimes it supervenes to bowel complaints, and the chronic pains remaining after acute pulmonary diseases. In the treatment, Dr. Bateman thinks gentle laxatives, and diaphoretics, with occasional anodynes, when the severe deep-seated pains occur, all that is necessary. No external application is requisite, unless the vesicles be abraded by the friction of the clothes, which are then liable to adhere to the parts: in this case a little simple ointment may be interposed. For a fuller account, see *Bateman's Pract. Synopsis*, p. 226, &c.

Herpes circinatus, or *ringworm*, makes its appearance in small circular patches, in which the vesicles arise only round the circumference; these are small, with moderately red bases, and contain a transparent fluid, which is discharged in three or four days, when little prominent dark scabs form over them. The central area, in each vesicular ring, is at first free from any eruption; but, the surface becomes somewhat rough, and of a dull red colour, and throws off an exfoliation, as the vesicular eruption declines, which terminates in about a week, with a falling off of the scabs. A succession of these vesicular circles usually arises on the face and neck, or arms and shoulders, thus protracting the case for two or three weeks.

The itching and tingling, which are the only inconveniences of the affection, may be relieved by the application of the popular remedy, ink, solutions of the salts of iron, copper, zinc, borax, alum, &c. Rayer has convinced himself that cold water, or linen wetted with cold water, is an equally beneficial application. (*Mal. de la Peau*, t. i. p. 246.) Some additional interesting observations on other forms of the herpes circinatus, may be found in Dr. Bateman's Synopsis, from which I have extracted the few preceding particulars.

Herpes præputialis. This local variety of herpes was not noticed by Dr. Willan, and we are indebted to Dr. Bateman for a description of it. The complaint begins with extreme itching, and with some sense of heat in the prepuce, on which one or two red patches occur, about the size of a silver penny. Upon these are clustered five or six minute transparent vesicles. In twenty-four or thirty hours, the vesicles enlarge, become of a milky hue, and lose their transparency; and on the third day, they are coherent, and have almost a pustular appearance. If the eruption is seated on that surface of the prepuce, which is next the glans, so that the vesicles are kept moist, they commonly break about the fourth or fifth day, and form a small ulceration upon each patch. This discharges a little turbid serum, and has a white base, with a slight elevation at the edges; and by an inaccurate or inexperienced observer it may be readily mistaken for chancre, more especially if any escharotic has been applied, which produces irritation, and a deep-seated hardness, like that of a true chancre. If not irritated, the slight ulceration begins to heal about the ninth or tenth day. When the patches occur on the outside of the prepuce, the duration of the eruption is shorter, and ulceration does not actually take place.

In the treament, Dr. Bateman recommends the avoidance of all stimulating, and moist or unctuous applications; and if the complaint be within the prepuce, he advises the interposition of a little bit of dry lint between the sore and the glans. (See also *Royston, in Med. Phys. Journ.* vol. xxiii.; *Evans, On Ulceration of the Genital Organs*, p. 27. 8vo., Lond. 1819; and *Obs. upon Herpes of the Prepuce*, in *Edin. Med. Journ.* vol. vii.)

As this gentleman has truly remarked, this case is particularly deserving of notice, because it has often been considered and treated as a chancre.

For additional information respecting herpes, I beg leave to refer the reader to the publications of Drs. Willan and Bateman, and that of M. P. Rayer, of which enlarged editions in French and English have recently appeared.

HORDEOLUM. (dim. of *hordeum*, barley.) A little tumour on the eye-lid resembling a barley-corn. *A stye.* As Scarpa remarks, the stye is strictly only a little boil, which projects from the edge of the eye-lids, frequently near the great angle of the eye. Like the furunculus, it is of a dark-red colour, much inflamed, and a great deal more painful than might be expected, considering its small size. The latter circumstance is partly owing to the vehemence of the inflammation, and partly to the exquisite sensibility and tension of the skin covering the edge of the eye-lids. On this account, the hordeolum very often excites fever and restlessness in delicate, irritable constitutions; it suppurates slowly and imperfectly; and, when suppurated, has no tendency to burst.

The stye, like other furunculous inflammations, forms an exception to the general rule, that the best mode, in which inflammatory swellings can end is resolution. For, whenever a furunculous inflammation extends so deeply as to destroy any of the cellular substance, the little tumour can never be resolved, or only imperfectly so. This event, indeed, would rather be hurtful, since there would still remain behind a greater or smaller portion of dead cellular membrane; which, sooner or later might bring on a renewal of the stye in the same place as before, or else become converted into a hard indolent body, deforming the edge of the eyelid, and termed *grando*.

The resolution of the incipient hordeolum may be effected in that stage of it, in which the inflammation only interests the skin, and not the cellular substance underneath, as is the case on the first appearance of the disease. Now repellent, cold applications are useful, particularly ice. But when the hordeolum has affected, and destroyed any of the cellular membrane underneath, every topical repellent application is absolutely useless, and even hurtful; and the patient should have recourse to emollient anodyne remedies. The hordeolum and eyelids should be covered with a warm soft bread and milk poultice, which ought to be renewed very often. When a white point makes its appearance on the apex of the little tumour, Scarpa says, the surgeon should not be in a hurry to let out the small quantity of serous matter, which exists between the skin and dead portion of cellular membrane. It is better that he should wait till the skin, within this white point, has become somewhat thinner, so as to burst of itself, and give ready vent, not merely to the little serous matter, but to all the dead cellular membrane, which constitutes the chief part of the disease. When the contents of the little tumour are slow in making their way outward, through the opening, the surgeon, gently compressing the base of the stye, ought to force them out. After this all the symptoms of the disease will disappear, and the cavity, left by the dead cellular membrane in the centre of the little tumour, will be found quite filled up, and healed in the course of twenty-four hours.

Sometimes, though seldom, this process of nature, destined to detach the dead from the living cellular membrane, only takes place incompletely, and a small fragment of yellow dead cellular substance still continues fixed in the cavity, and hinders the cure. In this circumstance, the further employment of emollient poultices is of little or no service. The surgeon should now touch the cavity with nitrate of silver scraped to a point, or, dip the point of a camel-hair pencil in sulphuric acid, and touch the inside of the stye with it, one or more times, until the sloughy cellular membrane comes away. After this, the small cavity remaining will soon close. Should the eye-lid continue afterwards a little swollen and œdematous, this affection may be removed by applying the lotio plumbi acet. containing a little spirit of wine. Some persons are often annoyed with this disease. This is most frequent in persons who live on acrid irritating food, and drink spirits. The stye, which occurs and relapses so frequently, in scrofulous children, is readily curable by means of sulphate of quinine, and rubbing the tumour, when not inflamed, with any smooth hard body, like a plain gold ring. (See *R. Middlemore, On Dis. of the Eye*, vol. ii. p. 772.) Chronic styes may occasionally be made to suppurate, by applying to them stimulating salves. (See *W. Mackenzie, On Dis. of the Eye*, p. 158. ed. 2.) (See *Scarpa, Sulle Malattie degli Occhi*, cap. ii. *Guthrie's Operative Surgery of the Eye*, p. 107. *R. Middlemore, On Dis. of the Eye*, vol. ii. p. 770. 8vo. Lond. 1835.)

HOSPITAL GANGRENE. (*Phagedæna Gangrænosa; Putrid or Malignant Ulcer; Hospital Sore; Gangræna Contagiosa.*) A severe and peculiar species of humid gangrene, or rather a combination of this affection with phagedenic ulceration. It is particularly characterised by its contagious or infectious nature; its disposition to attack wounds, or ulcers, in crowded hospitals, or other situations, where many of these cases are brought together; and its tendency to convert the soft parts affected into a putrid, glutinous, or pulpy substance, in which no trace of their original texture is discernible. (*Delpech, Précis Elém. des Mal. Chir.* t. i. p. 123.) It is generally believed to be communicated from one sore or wound to another, by its contagious nature; but whether the infection can be transferred only by actual contact, or both in this way, and through the medium of the atmosphere, is a question on which the best authors differ. The first origin of the disease, however, is a mysterious subject, which cannot invariably be explained on any certain principles, as will be hereafter noticed.

From the researches of Mr. Blackadder, it appears probable, that several of the ancient writers, in their descriptions of foul gangrenous bleeding ulcers, must have alluded to the same kind of disease, which is now usually denominated hospital gangrene. Besides the use of the actual cautery, which, according to the modern French writers, is the surest means of arresting this distemper, several of the ancients appear also to have employed for its cure arsenical applications; as, for instance, Ætius, Paulus, Rolandus, Avicenna, Guido, &c. The only doubt, whether these authors actually referred to hospital gangrene, depends upon their not having generally described its contagious nature. But, on this point, I recommend Mr. Blackadder's valuable treatise to be consulted. (P. 76, &c.)

Although La Motte made cursory mention of hospital gangrene in 1722, under the name of *pourriture*, and stated, that it had occurred in the Hôtel Dieu at Paris, the first distinct modern account of this disease is contained in the 3d vol. of the posthumous works of Pouteau, published in 1783. In the year 1788, Dussassoy, who succeeded Pouteau as chief surgeon of the Hôtel Dieu at Lyons, also published a short treatise on the disorder. The first very accurate description of hospital gangrene in the English language, appeared in the 6th vol. of the *London Medical Journal*, printed in 1785. The account is entitled, "Observations on the Putrid Ulcer, by Mr. Gillespie, surgeon of the Royal Navy." In the edition of Dr. Rollo's work on Diabetes, published 1797, there is a section on this subject, entitled, "A short account of a morbid poison, acting on sores; and of the method of destroying it." In 1799, Sir Gilbert Blane, in the 3rd edit. of his book on the Diseases of Seamen, gave an account of hospital gangrene under the name of malignant ulcer; and Dr. Trotter, in the 2d vol. of his *Medicina Nautica*, published in the same year, described that affection by the same appellation. In the third vol. of the same work, Dr. Trotter added to his first account several valuable communications, relating to this disease, received from surgeons of the royal navy. Mr. John Bell also made hospital gangrene the subject of particular remark, in the 1st vol. of his *Principles of Surgery*, published in

1801. According to Dr. Thomson, two excellent theses were likewise published on it in the University of Edinburgh: the first entitled, "De Gangrænâ Contagiosâ," by Dr. Leslie, in 1804; the second by Dr. Charles Johnson, in 1805, under the title of "De Gangrænâ Contagiosâ Nosocomiale." (See *Lectures on Inflammation*, p. 456—458.)

Professor Thomson's account of the subject, published in 1813, contained the fullest history of the disease, at that time collected. Boyer afterwards gave a very fair account of the distemper. (See *Traité des Mal. Chir.* t. i. p. 320., 8vo. Paris, 1814.)

These descriptions were followed by the valuable essay of Delpech, entitled, "Mémoire sur la Complication des Plaies et des Ulcères connue sous le nom de Pourriture d'Hôpital," 1815; some interesting observations by Dr. Hennen, in the *London Medical Repository for March*, 1815; a Paper by Professor Brugmann, of Leyden, in the "Annales de Littérature Med." vol. xix., 1815; and the treatise of Mr. Blackadder, which contains some of the best remarks ever made concerning this affection, and is entitled "Observations on Phagedæna Gangrænosa, 8vo. Edinb. 1818." To these publications are to be added the interesting remarks of Mr. R. Welbank, On Sloughing Phagedæna, contained in the 11th vol. of the *Med. Chir. Trans.*; and those of Dr. Boggie, recorded in the 3d vol. of the *Edin. Med. Chir. Trans.*

According to Mr. Blackadder, who is a believer in the doctrine of the complaint being only communicable by the direct application of the infectious matter, when the morbific matter, which produces the disease, has been applied to some part of the surface of the body, from which the cuticle has been removed, as by a blister, one or more small vesicles first appear, which are filled with a watery fluid, or bloody serum of a livid, or reddish-brown colour. The situation of the vesicle is generally at the edge of the sore. Its size is not unfrequently that of a split garden pea, and is easily ruptured, the pellicle which covers it being very thin. When the vesicle is filled with a watery fluid, and has not been ruptured, it assumes the appearance of a greyish-white, or ash-coloured slough; but when it contains a dark-coloured fluid, or has been ruptured, it puts on the appearance of a thin coagulum of blood, of a dirty, brownish-black colour. During the formation of the vesicle, there is generally a change in the sensation of the sore, accompanied with a painful feel like that of the sting of a gnat.

After a slough is formed, it spreads with more or less rapidity, until it occupies the whole surface of the original sore; and, when left to itself (which seldom happens), there is little or no discharge, but the slough acquires daily greater thickness.

"When the formation of the slough has been interrupted, the stinging sensation becomes more frequent and acute; phagedenic ulceration quickly commences; and such is frequently the rapidity of its progress, that even in the course of a few hours a very considerable excavation will be formed, while the parts in the vicinity retain their usual healthy appearance." The cavity, the edges of which are well defined, is filled with a thick glutinous matter, which adheres strongly to the subjacent parts. When this matter is removed, the surface underneath presents itself of a fine granular texture, which, in almost all instances, is possessed of extreme sensibility, and is very apt to bleed, when the operation of cleaning is not performed with great delicacy. At each dressing the circumference of the cavity is found enlarged, and if there are more than one, they generally run into each other. The progress of the disease is much quicker in some individuals than others, but *it never ceases, until the whole surface of the original sore is occupied.* The stinging pain gradually becomes of a darting or lancinating kind; and *either about the fourth, or sixth day, from the time when the morbific matter had access to the sore, or afterwards, at the period of what may be termed secondary inflammation, the lymphatic vessels and glands are apt to become affected.* The discharge becomes more copious, its colour varying from a dirty yellowish white to a mixture of yellow, black and brown, depending upon the quantity of blood mixed with it.

"The soft parts, in the immediate vicinity of the sore, daily become more painful, tumefied, and indurated; and, in a great number of cases, particularly in those of plethoric and irritable habits, an attack of acute inflammation speedily supervenes, and is accompanied by a great increase of pain, the sensation being described to be such as if the sore were burning. The period, at which this inflammation begins to subside, is by no means regular. Sometimes it subsides in the course of two days, and sometimes it continues upwards of five; depending very much on the constitution and previous habits of the patient, as well as the treatment that has been adopted. During its progress, the thick, putrid-looking, and frequently spongy slough which is formed on the sore, becomes more and more moist, and of a *pulpy* consistence. (Hence this form of disease is actually named by Gerson, *pulpy gangrene.*) In the course of a few days, a very offensive matter begins to be discharged at its edges. The slough then begins to separate; by and by, it is thrown off; but only to prepare the way for an extension of the disease by a continued process of ulceration, and by a recurrence of the last-mentioned symptoms." (*Blackadder, On Phagedæna Gangrænosa*, p. 28—30.)

The first symptoms, which indicate hospital gangrene in a wound, or ulcer, are, a more or less acute pain, and a viscid whitish exudation on the surface of the granulations, which lose their vermilion colour, and present at several points spots of a greyish or dirty-white hue, resembling venereal ulcers, or aphthæ. These ulcerated points, thus engrafted (as it were) upon the original ulcer, soon spread, and join together, so as to give to the whole surface of the solution of continuity a grey ash-colour. The surface also becomes more or less indurated, and sometimes bleeds. A red, purplish œdematous circle of a greater, or lesser extent, is next formed in the surrounding skin. Sometimes, when the patient is of a good habit, the causes of infection less active, and the constitution sufficiently strong, the disorder now stops. According to Boyer, it may not even extend to the whole surface of the ulcer. But, most frequently, its progress is extremely rapid, and occasionally quite terrifying. The edges of the wound, or ulcer, become hardened and everted; the granulations are large and tumid, being swelled up, as Boyer asserts, with a considerable quantity of gas. They are afterwards detached in the form of soft reddish sloughs, which very much resemble the substance of the fetal brain, in a putrid state. From day to day, until nature either alone, or aided by art, puts limits to the disorder, it invades new parts both in breadth and depth, so that its ravages extend to aponeuroses, muscles, blood-vessels, nerves, tendons, the periosteum, and even the bones themselves.

Amongst a number of severe cases, which fell under the notice of Mr. Blackadder, "there was one, in which the half of the cranium was denuded, the bones having become black as charcoal, and the integuments detached posteriorly to the second cervical vertebra, and anteriorly to the middle of the zygomatic process of the temporal bone; and this was originally a superficial wound of the scalp. In another case, the muscles, large arteries, and nerves of both thighs were exposed and dissected, the integuments and cellular substance being entirely removed, with the exception of only a narrow strip of the former, which remained on the outer side of the thighs. This was also originally a simple flesh wound. In other instances, the cavities of the knee, ankle, elbow, and wrist, joints were laid extensively open, and, in one unfortunate case, the integuments and cellular substance, on the anterior parts of the neck, were destroyed, exhibiting a horrid spectacle, the trachea being also wounded." (*On Phagedæna Gangrænosa*, p. 3.)

According to the last experienced author, when the disease attacks an old sore, where a considerable depth of new flesh has been formed, the first thing generally observed is a small dark-coloured spot, usually situated at the edge of the sore. But, he states, that, in several cases of ulcers, the disease, when carefully watched, was found to begin in the form of a vesicle, filled with a livid, or brownish-black fluid, which afterwards burst, and assumed the appearance of the dark coloured spot, which is commonly first noticed. Mr. Blackadder always found, that when there had been a considerable bed of new flesh formed, the phagedenic ulceration made comparatively a very slow progress, and put on rather the appearance of mercurial phagedena, until the morbific matter had found access to the natural texture of the part, when the progress of the disease became suddenly accelerated; acute inflammation supervened; and a large slough was formed. (*Op.* cit. p. 31.) He notices, that when the mobific matter is inserted in a puncture, or scratch, the first progress of the disease bears a resemblance to that of a part inoculated with vaccine matter. The primary inflammation in gangrenous phagedena commences at the end of the second, or early on the third day; the inflammation is at its height about the sixth; when the scab begins to form in one disease, phagedenic ulceration begins in the other, and, when allowed to proceed, soon affords sufficient proof of the non-identity of the two diseases. (P. 33.)

When the disease attacks a recent gunshot wound, the discharge, two or three days after infection, is found to be lessened, and to have become more of a sanious, than purulent nature. The sore has a certain dry and rigid appearance; its edges are more defined, somewhat elevated, and sharpened; the patient is sensible of a change in the usual sensation in the sore, and complains of an occasional stinging sensation, resembling that produced by the sting of a gnat. At this period, but sometimes a day or two later, the integuments at the edge of the sore become inflamed, and the surface of the sore itself assumes a livid or purple colour, and appears as if covered with a fine pellicle, such as is formed on a coagulum of blood. (*On Phagedæna Gangrænosa*, p. 33.)

At Bilboa, the disease, in cases of wound, is said generally to have commenced with a sudden attack of severe pain in the head and eyes, tightness about the forehead, want of sleep, loss of appetite, a quick pulse, and other febrile symptoms; while the wound, which had been healthy and granulating, at once became tumid, dry, and painful, losing its florid colour, and assuming a dry and glossy coat. (*Hennen, On Military Surgery*, p. 214. ed. 2.) When left to itself the above-described pellicle gradually increases in thickness, forming what has been termed a slough. But, Mr. Blackadder observes, that, at this period, the process of the disease is hardly in any two instances precisely alike. Generally, in the course of from five, to ten, or fifteen days, a thick spongy, and putrid-looking slough is formed over the whole surface of the sore, and which is more or less of an ash, or blackish-brown colour. When the pellicle is destroyed, as frequently happens in the process of cleaning, it is not in every case reproduced; but, an offensive matter begins to be discharged, which becomes daily more copious, and of a dirty yellow colour, and ropy consistence, and very adherent to the sore. The substance, which formed the apparent bottom of the wound, is raised up, and pushing back the edges, makes the sore appear considerably enlarged. The edges, which are usually jagged, or pectinated, become extremely irritable, of a deep-red colour, and dotted, on their inner surface, with numerous small, elevated, and angry-looking points, *which may be considered as one of the characteristic marks of the disease.* The surrounding integuments become indurated and inflamed, assuming, not unfrequently, an ansarine appearance; and the patient complains of a constant burning, lancinating pain. In the vicinity of the sore, the integuments become more and more of a dark-red colour, in consequence of the violence of the inflammation, which is of an erysipelatous nature, and apt to terminate in sloughing, and carry off the patient. However, the inflammatory symptoms are sometimes mild, and, in other cases, exceedingly violent; a fact accounted for by differences of constitution. (*Blackadder*, p. 34.)

In the hospitals at Bilboa, if the incipient stage was overlooked, the febrile symptoms very soon became aggravated; the skin around the sore assumed a highly florid colour, which shortly became darker, then bluish, and at last black, with a disposition to vesicate; while the rest of the limb betrayed a tendency to œdema. All these threatening appearances occurred within twenty-four hours, and, at this period, also, the wound, *whatever might have been its original shape, soon assumed the circular form.* The sore now acquired hard, prominent, ragged edges, giving it a cup-like appearance, with particular points of the lip of a dirty yellow hue, while the bottom of the cavity was lined with a flabby blackish slough. The gangrene still advancing, fresh sloughs were rapidly formed; the increasing cup-like cavity was filled up and overtopped by them, and the erysipelatous livor and vesication of the surrounding skin gained ground, while chains of inflamed lymphatics could be traced from the sores to the adjoining glands, these exciting inflammation and suppuration, which often furnished a new nidus for gangrene. The face of the sufferer assumed a ghastly anxious appearance: his eyes became haggard and deeply tinged with bile; his tongue covered with a brownish, or blackish fur; his appetite entirely failed; and his pulse was feeble and accelerated. In this stage, the weakness and irritability of the patient was such, that the slightest change of posture put him to torture, increased by his inability to steady the limb, which, if lifted from the bed, was seized with tremors and spasmodic twitches. (*Hennen's Military Surgery*, p. 215, 216. ed. 2.) Authors vary considerably in their descriptions of the state of the tongue. Dr. Hennen found it brownish, or blackish; Delpech whitish, or yellowish. (*Précis Elém.* t. i. p. 125.); and Mr. Blackadder, covered with a white mucus. (P. 39.)

It is explained by Mr. Blackadder, that when the disease attacks a large recent wound, the whole surface of the injury is sometimes affected from the first; while, in other instances, the disorder commences on, or near the lips of the sore. When the patient is of an inflammatory diathesis, the sore is generally attacked with acute inflammation between the seventh and fourteenth days; and the slough is softer, and of a pulpy consistence; matter, of a strong and peculiar odour, and of a dirty brownish, grey colour, begins to ooze out at its edges, and becomes daily more copious. The inflammation gradually subsides; the slough becomes loosened, and finally detached, leaving the subjacent muscles, bones, fasciæ, or ligaments, completely exposed. When the constitution is not prone to acute inflammation, the slough remains long adherent; the discharge is very copious, and burrows under the skin, which then mortifies. Sometimes, after the detachment of a slough, florid granulations spring up, and, notwithstanding a slight recurrence of the phagedenic ulceration, the parts heal up by the almost unassisted operation of nature. However, most commonly, after the muscles are exposed, they continue to be gradually dissected; their connecting cellular membrane is completely destroyed, and they are left covered with an offensive, greasy-looking matter.

According to Mr. Blackadder, when a muscle has been wounded, it swells sometimes to a great size, and quickly assumes the appearance of a large coagulum, being altogether deprived of irritability. When it has not been wounded, but has become inflamed, it generally assumes a pale colour, with an appearance as if distended with a fluid, and, occasionally, before losing its vitality, acquires a very surprising bulk; but, when no inflammation has supervened, the muscles become of a pale brick colour, waste away daily, and the patient loses all power in them. As the disease advances, the integuments are undermined, and slough; and hemorrhage from small vessels is a common occurrence; but, in a more advanced stage, some of the large vessels are apt to give way, and the bleeding from them frequently destroys the patient.

"When a stump is the site of the disease, and the patient is of a plethoric habit, or accustomed to live freely, the symptoms soon begin to indicate the existence of an intense inflammatory action through its whole substance, the tumefaction, pain, and heat increase rapidly, so that, in a few days, the stump shall have acquired more than twice its former size, being at the same time much indurated, and causing the most excruciating pain. In this state, the patient has, in some instances, become delirious, and has been cut off by an effusion taking place into some of the larger cavities. It more commonly happens, however, that gangrene seizes upon the integuments, and cellular substance; large sloughs are thrown off; and some of the large blood-vessels giving way, the patient sinks under the effects of repeated hemorrhage. For it is commonly found, that the usual modes of stopping hemorrhage from a stump are, in such cases, either inadmissible, or totally inefficacious.

"Sometimes, the progress of the disease in a stump is more gradual, but in the end nearly as fatal; the inflammation is much less acute; there is comparatively but little tumefaction, and the pain is much less severe; but, the discharge is much more copious, and the cellular substance, connecting the integuments and muscles, is rapidly destroyed. Hemorrhage generally comes on later than in the preceding instance, but it is the most common cause of death." (*Blackadder on Phagedæna Gangrænosa*, p. 33—39.)

It is observed by another writer, that artery seems to be the texture, which resists most powerfully the destructive action of hospital gangrene (*Thomson's Lectures*, p. 460.); a remark quite at variance with the statement of Delpech (*Précis Elém.* t. i. p. 129.); but intended to refer, as I conceive, to cases in which the femoral, brachial, or other large artery is seen for several days completely denuded, in the midst of the ravages of the distemper, yet not giving way. I have seen the same thing frequently exemplified in mercurial phagedena, as well in the groin as in the arm. As for the smaller arteries, they are quickly destroyed, together with other parts.

"In some rare cases (says Dr. Hennen) I have seen the femoral and axillary arteries pulsating awfully, and apparently unaffected with disease; while all the surrounding parts were completely destroyed; but, in a vast majority of cases, the blood-vessels partook of the general disease, in which they were imbedded. They were not only completely separated from their natural connections, but their coats sloughed away at the immediate point of disease, while the disposition extended far beyond the apparently affected spot. Hence, our ligatures but too often failed on the main branches, and any attempt on the smaller was invariably injurious. We were here naturally induced to tie the artery considerably above the seat of the disease; and this was done once on the femoral, and twice on the axillary artery below the clavicle: the former burst on the third, each of the latter on the second day, afterwards." Dr. Hennen further remarks, that, in general, the great vessels sloughed long after the acute symptoms of the disease had abated, and that, in severe cases, the eleventh day of the disease was always dreaded. (*On Military Surgery*, p. 221. ed. 2.) The indisposition of the large vessels to close, when taken up in the common way, appears referrible to three causes: viz. the tendency to rapid ulceration in the arteries in the situation of the ligatures; the formation of no effectual coagulum in the extremity of the vessel, like what happens in other cases of mortification; and the general incapacity of nature in examples of hospital gangrene to establish any process, which can be accompanied with healthy adhesive inflammation.

In the last stage of the disease, as it occurred in the military hospitals at Bilboa, the surface of the sore was constantly covered with a bloody oozing, and, on lifting up the edge of the flabby slough, the probe was tinged with dark-coloured grumous blood, with which also its track became immediately filled. Repeated and copious venous bleedings now came on, which rapidly carried off the patient: the sloughs, whether they fell off spontaneously, or were detached by art, were quickly succeeded by others, and brought into view thickly-studded specks of arterial blood. At length, an artery gave way, which was generally torn through in the attempt to secure it with a ligature: the tourniquet, or other pressure, was now applied, but in vain; for, while it checked the bleeding, it accelerated the death of the limb, which became frightfully swelled and horribly fetid. Incessant retchings came on, and with coma, involuntary stools, and hiccough, closed the scene. Often, however, the patient survived this acute state of the disease, and sank under severe irritation, absorption of putrid matter, and extensive loss of substance, with common hectic symptoms. (See *Hennen's Mil. Surgery*, p. 217. ed. 2.) In the disease at Bilboa, the skin and cellular substance seemed to be the parts originally and principally affected. This, says Dr. Hennen, was obvious, even in the living body; but, on dissection, the disease of these parts was frequently observed to spread much further, than external appearances indicated, as a diseased track was often found running up into the groin, or axilla, and completely dissecting the muscles and great vessels. (*On Military Surgery*, p. 219. ed. 2.) When the disease had occupied the outside of the chest, the same gentleman found the lungs in two cases, and the pericardium in a third, covered with gangrenous spots; and when the parietes of the abdomen had been attacked, he often observed the same appearances on the liver. (P. 220.)

Hospital gangrene must be regarded as one of the most serious and dangerous complications, to which wounds and ulcers are liable. When the solution of continuity is large, or of long standing, the disorder commits great ravages, renews its attacks repeatedly, and the relapses prove exceedingly obstinate. The same thing is said to happen, when it affects persons labouring under scorbutic or venereal complaints. Hospital gangrene proves particularly dangerous, and mostly fatal, when it complicates large contused wounds, attended with badly fractured bones. All the soft parts of the injured limb are then frequently observed to be progressively destroyed, and the unfortunate patient falls a victim, either to typhoid symptoms, frequent hemorrhages, or hectic complaints. From what has been stated, however, the disease varies considerably in its severity in different cases, being sometimes of small extent, and even capable almost of a spontaneous cure. Patients have been known to continue afflicted more than a month; and when the duration of the disease was thus lengthened, the cases almost always had a fatal termination. In a few cases, the wound puts on a favourable appearance again between the sixth and ninth days; and, in slight examples, the amendment is manifested between the third and fifth. Whatever may be the period of the complaint, its wished-for termination is always announced by a diminution of pain; the pus acquiring a white colour, and more consistence, and losing its fetid nauseous smell. The edges of the ulcer subside, while its surface becomes less irregular, and puts on more of the vermilion colour. The red, purplish, œdematous circle, which surrounds the disease, assumes a true inflammatory nature; and the solution of continuity, restored to a simple state, heals up with tolerable quickness, even when the destruction of soft parts is somewhat considerable, unless any fresh untoward circumstances occur to interrupt cicatrisation. But sometimes, when the patient is on the point of being completely well again, his condition is suddenly altered for the worse; ulcerated spots make their appearance on the cicatrix, and these spreading in different directions occasion a relapse, which may happen several times.

According to Dr. Boggie, a relapse, and even repeated relapses, are very common, as his own experience fully convinced him; and he adverts to a case reported by Dr. Hennen, in which the patient survived twelve different attacks, and sunk under the thirteenth. (See *Edinb. Med. Chir. Trans.* vol. iii. p. 8.) So far as the observations of Dr. Boggie went, hospital gangrene was more frequent and severe in hot weather than cold. (See *Edinb. Med. Chir. Trans.* vol. iii. p. 13.)

From numerous cases of this disease, seen by Mr. Blackadder at Passage, in Spain, this gentleman made the following conclusions: —

1. That the morbid action could almost always be detected in the wound, or sore, *previously to the occurrence of any constitutional affection.*

2. That in several instances, the constitution did not become affected, until some considerable time after the disease had manifested itself in the sore.

3. That when the disease was situated on the inferior extremities, the lymphatic vessels, and glands in the groin, were observed to be in a state of irritation, giving pain on pressure, and were sometimes enlarged, before the constitution showed evident marks of derangement.

4. That the constitutional affection, though sometimes irregular, was in many cases contemporary with the second, or inflammatory stage.

5. That all parts of the body were equally liable to become affected with this disease.

6. That when a patient had more than one wound, or sore, it frequently happened, that the disease was confined to one of the sores, while the other remained perfectly healthy, and this even when they were at no great distance from each other. (*On Phagedæna Gangrænosa*, p. 19.)

Thus, Mr. Blackadder espouses the opinion, that hospital gangrene is at first a *local*, and not a *constitutional disease*, that is to say, not necessarily preceded, or originally accompanied, by any diseased action in the system. It is highly important to weigh this distinction well; not only because it is yet the chief point of difference amongst the best writers on this subject, but because it involves very directly every theory, respecting the causes of the disease, and the great question, whether its ravages are to be resisted principally by local or constitutional means, or by remedies of both descriptions together.

In the hospital gangrene, observed by Dr. Rollo in the Artillery Hospital at Woolwich, "the action of the poison seemed to be limited and confined to specific effects. *The first were local, producing only a general affection, by a more extensive operation on the sore.* Five or six days from the appearance of the small ulcer or ulceration, when it had extended over one third of the former sore, with pain and redness in the course of the lymphatics, and the glands, through which they led, with enlargement of them, general indisposition of the body became evident." Delpech, in his interesting memoir, particularly notices, that the constitutional symptoms *always occurred the last in order of succession.*

Mr. Blackadder distinctly declares, that in no instance, which he had had an opportunity of observing, did the constitutional symptoms of gangrenous phagedæna precede the local, unless the case be held an exception, in which a stump became affected, after amputation had been performed, on account of the previous effects of the disease. The period, at which the constitution begins to exhibit symptoms of irritation, (he says) is extremely irregular,—sometimes as early as the third or fourth day, and sometimes even as late as the twentieth. The countenance assumes an anxious, or feverish aspect; the appetite is impaired; the desire for liquids increases; and the tongue is covered with a white mucus. The bowels are generally rather constipated; and the pulse, what may be termed, rather irritated, than accelerated. But, the general symptoms may assume an inflammatory, or typhoid character, according as the causes of one of these modifications may predominate. According to Mr. Blackadder, when an inflammatory diathesis prevails, the system becomes gradually more irritated, until an attack of acute inflammation seizes upon the sore, and which frequently happens about the end of the second week. At this period, the pulse is frequent and sharp, and it is not uncommon for the patient to be seized with one or more shivering fits, succeeded by a great increase of heat, but seldom or never terminating in a profuse perspiration. The cold fit is sometimes followed by a bilious discharge from the intestines, and mitigation of the febrile disorder. If the local mischief be not arrested, the strength becomes daily more and more exhausted; the fever loses its inflammatory character; and, unless the patient be cut off by hemorrhage, he falls a victim to extreme debility. When the disease has a typhoid character, the pulse is small and frequent; the appetite and strength gradually fail; and the patient at last sinks, retaining his mental faculties to the last. Not unfrequently, diarrhœa hastens the event. (*Blackadder on Phagedæna Gangrænosa*, p. 39, 40.)

The sloughing phagedæna seen by Mr. R. Welbank, generally in the cleft of the nates, in the groin, or at the inner and upper part of the thigh, in the lowest class of prostitutes, and, according to his description, certainly resembling hospital gangrene, was attended, in its early stages, with little or no disturbance of the system; a circumstance which he also mentions as favourable to the doctrine that the disease is of a local nature. (See *Med. Chir. Trans.* vol. xi. p. 365.)

On the other hand, the generality of writers, nay, even some of those who represent the disease as always proceeding from a species of infection applied to the wound, take into the account the operation of constitutional causes, as predisposing to, and of course preceding, the local symptoms. Dr. J. Thomson believes, that the constitutional symptoms mostly precede the local. (*On Inflammation*, p. 459.) The same sentiment is professed throughout Dr. Hennen's remarks, who placed reliance chiefly upon internal remedies, and regarded external applications as merely a secondary object. (*On Military Surgery*, p. 222. ed. 2.) To this part of the subject I shall return, after adverting to the causes of hospital gangrene.

The hospital gangrene, which occurred in the Artillery Hospital at Woolwich, and was described by Dr. Rollo, did not attack specific sores; venereal, scrofulous, and variolous ulcers were not attacked, although the patients lay in the wards, where the disease prevailed.

Professor Thomson admits, that specific sores are less liable to attacks of hospital gangrene, than common wounds and ulcers; but he declares that he has frequently seen it attack cancerous and venereal ulcers. (*On Inflammation*, p. 460.)

Dr. Hennen mentions a remarkable instance, which also proves the possibility of a specific sore becoming affected, and fatal from this cause, in forty-eight hours after the patient had first been exposed to the infection. Dr. Hennen relates the fact to prove, that the contagion may be received without a long residence in a tainted air. The patient "who had just landed from England, and was under the influence of mercury, employed for a venereal complaint, died within forty-eight hours after his admission, the gangrene having seized on an open bubo in his groin, eroding the great vessels in the neighbourhood, and absolutely destroying the abdominal parietes to a large extent." (*Principles of Military Surgery*, p. 218. ed. 2.)

The effects of hospital gangrene should be carefully discriminated from those of the scurvy. Ulcers attacked with hospital gangrene, are not affected in any degree like scorbutic ulcers, by the use of vegetable diet and lemon-juice; and they occur among men, who are fed upon fresh meat and vegetables, as readily as they do among those who have been fed altogether upon salt provisions. (*Thomson's Lectures on Inflammation*, p. 482.) Hospital gangrene is almost always accompanied with severe febrile symptoms; but, "as to fevers (says Dr. Lind), it may indeed be doubted whether there be any such as are purely and truly scorbutic. The disease is altogether of a chronic nature; and fevers may be justly reckoned amongst its adventitious symptoms." (*Treatise on the Scurvy*, p. 106.) In cases of hospital gangrene, the general symptoms of scurvy are also absent, such as soreness and bleeding of the gums, livid blotches and wheals on the fleshy part of the legs, œdematous, ankles, &c.

Hospital gangrene (says Boyer) is a species of humid gangrene, which attacks in some degree *epidemically* the wounds and ulcers of patients, who happen to be crowded together in an unhealthy place.

Its occasional causes are: the situation of an hospital upon a low marshy ground; the vicinity of some source of infection; the uncleanliness of the individuals, or of the articles for their use; the crowded state of the wards, especially when they are small and badly ventilated; lastly, every thing that tends to corrupt the air which the patients breathe. An infected atmosphere may produce in the most simple wounds unfavourable changes, partly, as Boyer conceives, by its immediate action on the surface of the wound, but no doubt, principally, by its hurtful influence upon the whole animal economy. The foregoing causes have also sometimes produced alarming and obstinate gangrenes of an epidemic kind, or, at least, a state of the constitution, under the influence of which all wounds and ulcers constantly took on a bad aspect, and were often complicated with the worst gangrenous mischief. Vigaroux saw such an epidemic disease prevail for twenty months in the two hospitals of Montpellier; and he states, that the most powerful antiseptics were of little avail against the disorder, which often invaded the slightest scratches.

In general, this epidemic species of gangrene is not observed in new-built hospitals, nor in those, which are erected out of the central parts of cities upon high ground. Hospital gangrene may occur in any season; but, it is most common after the sultry heat of summer.

A bilious constitution, mental trouble, unwholesome or insufficient food, a scorbutic diathesis, great debility, and fevers of a dangerous type, are also reckoned by the French surgeons as so many predisposing causes of hospital gangrene.

The observations of Pouteau, and those of some other practitioners, convincingly prove, that hospital gangrene may be communicated to the most simple wound or ulcer in a subject of the best constitution, and breathing the purest air, by merely putting into contact with such wound, or ulcer, sponges, lint, or charpie, impregnated with the infection of this peculiar disorder. But this inoculation is conceived to be the more alarming, and to take effect the more quickly, in proportion as patients have been more exposed to the influence of such causes as are themselves capable of producing the disease, and also in proportion as the kind of constitution predisposes to it.

Although the contagious nature of hospital gangrene has been generally admitted by all the best informed writers on the subject, the doctrine was not considered by Dr. Trotter as having a good foundation. Modern authors, however, have not joined this latter gentleman, and Dr. J. Thomson, Dr. Hennen, Mr. Blackadder, and Mr. R. Welbank, all believe, that the disorder is infectious. "The contagious nature of hospital gangrene (says Professor Thomson) appears to me to be sufficiently proved, 1st, By the fact, that it may be communicated by sponges, charpie, bandages, and clothing to persons at a distance from those infected with it. 2dly, By its having been observed to attack the slight wounds of surgeons, or their mates, who were employed in dressing infected persons; and that even in circumstances where the medical men so employed did not live in the same apartment with the infected. 3dly, By our being able often to trace its progress distinctly from a single individual through a succession of patients. 4thly, By its attacking recent wounds, as well as old sores, and that in a short time after they are brought near to a patient affected with the disease. 5thly. By our being able to prevent the progress of the disease in particular situations, by removing the infected person, before the contagion, which his sores emit, has had time to operate. 6thly, By its continuing long in one particular ward of an hospital, or in one particular ship, without appearing in other wards, or ships, if pains be taken to prevent intercourse between the infected and uninfected." (*Lectures on Inflammation*, p. 484.) But although there can be no doubt of the disease spreading partly by its contagious nature, it appears to me equally certain, that the number of cases is also often increased by the continued operation of the same causes, which produced the earliest instance of the disorder in any particular hospital. A similar belief is expressed by Dr. Boggie. (See *Edin. Med. Chir. Trans.* vol. iii. p. 25.)

It is alleged, that when once a patient has taken the infection, he cannot avoid the consequences, whatever precautions he may adopt. Thus, Boyer informs us, that he has seen hospital gangrene take place in wounded patients, who, in the hope of escaping this epidemic affection, had quitted the infected hospital, and retired to elevated situations, where they breathed the most salubrious air. (See *Traité des Mal. Chir.* t. i. p. 322.)

The bad state of the air of a crowded hospital as Mr. Blackadder observes, is a ready means of accounting for the origin of phagedæna gangrænosa; but there are various reasons for considering such explanation not altogether satisfactory; and he mentions a case, in which the wound of a soldier was found affected with the disease, on his first arrival at an hospital, after having been accidentally detained with two other wounded comrades, for five or six days, partly in an open building, and partly in a boat, quite exposed to stormy weather. (p. 45.); Dr. Hennen likewise gives an account of about thirty fresh-wounded men, in whom hospital gangrene first appeared in their journey from Vittoria to the hospital near Bilboa. (*Principles of Military Surgery*, p. 214. ed. 2.) Dr. Rollo also remarked, that some men in quarters were affected with this disease. And according to Mr. J. Bell, "there is no hospital, however small, airy, or well regulated, where this *epidemic* ulcer is not to be found at times." (*Principles of Surgery*, vol. i. p. 112.) For a refutation of the opinion, that the disease strictly merits the epithets *endemial*, and *epidemic*, I must refer the reader to the observations of Mr. Blackadder. (P. 143, &c.) Delpech remarks, that the causes of the disease do not appear to have depended upon the state of the atmosphere (p. 25.); and in almost every instance, *he traced the propagation of the disorder to the direct application of the morbific matter to the sores.* However, he joins Pouteau in the belief, that it may be communicated through the medium of the atmosphere; an occurrence, which Mr. Blackadder doubts, or rather considers as very rare and only possible, where the effluvia are allowed to accumulate in a most negligent manner, so as to resemble a vapour bath, which mode he would also regard as equivalent to inoculation. (*On Phagedæna Gangrænosa*, p. 156.) On the whole, I am disposed to think the views, which Mr. Blackadder has taken of the manner in which the disease is communicated, the most correct, and that, while particular states of the air and constitution certainly modify the disorder, they cannot generally have any share in giving origin to the disease: I say *generally*, because, as various facts oblige us to admit, that hospital gangrene sometimes arises, without having been communicated from any patient previously affected, it is impossible to assert, that the earliest example of it, under such circumstances, may not arise from the operation of some unknown and inexplicable circumstances on the constitution, or, in other words, from the state of the system itself. Nor can a doubt be entertained, that, at all events, the disorder is most apt to break out in crowded, badly ventilated hospitals, and in them appear more extensively and malignantly, than in others which are well regulated, properly ventilated, and healthily situated. But the idea entertained by Delpech, that hospital gangrene may originate from the same contagion as typhus, or other diseases, is merely an unsupported, irrational, conjecture, quite as destitute of truth, as the suppositions about the endemial and epidemic character of the complaint, independent of its infectious nature. The question, how the first example of the disorder originates, is at present a perfect mystery; but, as it cannot be referred to contagion, or inoculation, we should recollect, that whatever produces it in one individual, may produce it in another, similarly circumstanced, and, on this principle, the disorder may sometimes be formed independently, and at the same time, in a greater or lesser number of patients in the same hospital, as well as spread from these to others by infection.

With the view of preventing the disorder, the wards, in which the wounded are placed, should not be crowded; they ought to be freely ventilated, and, if possible, not communicate. The utmost attention to cleanliness should be paid, and all filth and stagnant water removed. It has been asserted, but with what accuracy I cannot determine, that the predisposition of the wounded to this species of gangrene may be lessened by a well-chosen diet, by drinks acidulated with vegetable acids, or with the sulphuric acid, and by the moderate use of wine. The state of the stomach and bowels should be particularly attended to, and, if out of order, emetics and purgatives ought to be immediately employed, and repeated according to circumstances. The dressings should be applied with extreme attention to cleanliness, and too much care cannot be taken to prevent the infectious matter of one wound from coming into contact with another through the medium of sponges (see *Welbank* in *Med. Chir. Trans.* vol. xi. p. 365.), instruments, &c. "Whatever may be the source of the disease (says a late writer), it is at least sufficiently ascertained, that when it occurs, its propagation is only to be prevented by the most rigid attention to cleanliness, and by insulating the person, or persons affected, so as to prevent all direct intercourse between them and the other patients; for, so far as I have had an opportunity of observing, ninety-nine cases in the hundred were evidently produced by a direct application of the morbid matter to the wounds, dressings, &c.; while others, who were, in every other respect, equally exposed to its operation, never caught the disease. In attempting to prove this by experiment, I have placed three patients with clean wounds alternately between three other patients, severely affected with the disease. They lay in a part of a ward, which was appropriated for patients who were labouring under the disease, and of whom there were at the time a considerable number. Their beds were on the floor, and not more than two feet distant from each other; but, all direct intercourse was forbidden, and they were made fully aware of the consequences that would follow from inattention to their instructions. The result of this trial was, that not one of the clean wounds assumed the morbid action peculiar to the disease, nor was the curative process in any degree impeded." (*Blackadder on Phagedæna Gangrænosa*, p. 46.)

As many experienced writers assert, that the disease may also be communicated from one person to another through the medium of effluvia in the air, I am firmly persuaded that, in the present state of our knowledge of the subject, the cautions respecting ventilation and cleanliness (the chief practical deduction from the latter doctrine) are highly necessary and important. This sentiment may be adopted, without implicit faith being placed in the opinion, that the disorder can actually be transmitted from one person to another through contagion in the air, because, whether the last idea be true, or not, attention to cleanliness and ventilation must be beneficial to the health, in this, as in every other species of gangrene; and, on this principle, it must be serviceable in diminishing the severity, if not the frequency and extent, of the disease, as I am myself disposed to believe from the consideration of all the evidence adduced. These observations are strengthened by the fact, that it was chiefly in the foul wards of St. Bartholomew's Hospital that the disorder committed its ravages in that institution. (See *Med. Chir. Trans.* vol. xi. p. 365.) Where circumstances will permit, an entire removal of the patients from the place, in which the disease has either had its first formation, or spread to any extent, appears likewise to be a most beneficial measure. But, when this change of the wards, or hospital, is impracticable, the air which the patients breathe, should be purified, by renewing it as much as possible, fixing ventilators, and especially by using the oxygenated muriatic acid fumigations, as recommended by Guyton-Morveau, or else those of the nitric acid.

The nitric acid fumigations are made by putting into a glass vessel, on the ground, half an ounce of concentrated sulphuric acid, to which an equal quantity of nitre is to be added *gradatim*. The mixture is to be stirred with a glass tube, when an abundance of white vapour will be produced.

The oxygenated muriatic acid fumigations are made, by mixing three ounces two drams of common salt with five drams of the black oxyde of manganese in powder. These two ingredients are to be triturated together; they are then to be put into a glass vessel; one ounce two drams of water are to be added, and then, if the ward or chamber be uninhabited, one ounce seven drams of sulphuric acid are to be poured upon the mixture all at once; or, gradually, if the patients are there. This quantity will be sufficient for a very large ward.

When one or more of the patients, afflicted with the disorder, before it has become general, are lying in a badly ventilated part of the ward, the surgeon can partly counterbalance the disadvantage of not having a fresh ward, by causing the patients to be put into a more airy part of the ward, and as far as possible from the quarter in which they contracted the disease.

With regard to internal medicines, while irritation and febrile heat accompany hospital gangrene, diluent acid drinks are proper, such as nitrated whey sweetened with syrup of violets, lemonade, &c. Blood-letting is admissible in but few instances; not merely because the orifice made by the lancet may, according to some accounts, become gangrenous, but because the fever, which accompanies hospital gangrene, is usually of the typhoid character. (*Thomson*, p. 493.)

Mr. Blackadder, like Dr. Thomson, does not entertain a favourable opinion of venesection, as a general practice, though he would not object to the abstraction of a small quantity of blood, when, owing to the plethoric habit of the patient, *previous treatment*, and other causes, an inflammatory action in the system is present. The same practice, under similar conditions, is also sanctioned by Dr. Boggie. (*Edinb. Med. Chir. Trans.* vol. iii. p. 34.) Mr. Blackadder conceives, that all danger of the disease attacking the wound made with the lancet may be obviated, if care be taken that the arm of the patient, the hands of the surgeon, his lancet, and the subsequent dressings, be perfectly free from contamination, and that the patient be prevented from undoing the bandage, or touching the incision made with the lancet, before it is cicatrised. (P. 135.) Dr. Boggie has bled many in this disease, but never seen a single instance of gangrene after the operation. (*Edinb. Med. Chir. Trans.* vol. iii. p. 35.) Mr. Blackadder thinks, however, that blood-letting should be avoided as much as possible, particularly when the previous injury has been extensive. " A general debility of the system, is one of the symptoms which are most to be dreaded; for, when once it takes place, there is no other disease in which it is removed with greater difficulty." (P. 137.) How different these sentiments are from those of Dr. Hennen, who, in speaking of the effects of venesection, when the disorder was accompanied with an inflammatory diathesis, employs the following expressions: "The very patients themselves implored the use of the lancet." For several months "we used no other remedy, either as a cure or preventive."—" We never observed any of the lancet-wounds assume a gangrenous appearance, although previously, in almost every other instance, the slightest puncture festered." (*On Military Surgery*, p. 224. ed. 2.) Mr. Welbank also states, that moderate venesection may be adopted with advantage while the disease is superficial, and the constitution not much affected, particularly in plethoric habits. (*Med. Chir. Trans.* vol. xi. p. 368.)

In the beginning of the constitutional attack, Pouteau and Dussassoy particularly recommended emetics; and Mr. Briggs, Dr. J. Thomson, and Dr. Hennen, are all advocates for this practice, though the latter gentleman makes his evidence rather ambiguous, by a subjoined note, in which he mentions that want of success, &c. led to the trial of venesection. (*Op.* cit. 222.) As for Mr. Blackadder, he deems the employment of emetics at the commencement of hospital gangrene useful only when the stomach is foul. (*On Phagedæna Gangrænosa*, p. 134.) Dr. Boggie found emetics generally very inferior to purgatives. (*Edinb. Med. Chir. Trans.* vol. iii. p. 37.) He chiefly approves of them when the stomach is loaded, and the fever of a bilious character. In the early stage of the case, writers seem all to agree about the utility of purgative and laxative medicines. When there is debility, good generous wine should be allowed, either by itself, or mixed with lemonade, according to circumstances. Bark is in general more hurtful than useful: Mr. Welbank objects to it generally, on account of the common disposition to diarrhœa in the advanced stages of the disease (*Med. Chir. Trans.* vol. xi. p. 368.); and Dr. Hennen assures us, that he has seen great harm done by large and injudicious doses of this drug, before full evacuations had taken place, and the sloughs begun to separate. Boyer allows, however, that it may be beneficially given, when the feverish heat has abated, and the debility is very great.

In all stages of this disease, unattended with diarrhœa, acids are proper. The sulphuric acid is that which is given with most success; but the acidulous tartrate of potassa is also an excellent medicine. From two drams to half an ounce may be given every day, and the best plan is to make an acid drink with it, which should be sweetened and strained.

In severe cases, attended with a quick and feeble pulse, depression, restlessness, and anxiety, an opiate becomes necessary. " So long as we wish to excite a degree of moisture on the skin (says Professor Thomson), Dover's powder, or laudanum with antimonial wine, form in general the best opiates." This gentleman, however, is not an advocate for the employment of opium, in the early stage of hospital gangrene, while the heat and other febrile symptoms are at their height. (See *Lectures on Inflammation*, p. 494, 495.) According to Mr. Welbank's experience, narcotics are beneficial, and he has seen a most irritable state of the stomach improve rapidly, and a foul furred tongue become clean, on the administration of large doses of opium at regular intervals. (See *Med. Chir. Trans.* vol. xi. p. 368.) Camphor, in large and frequent doses, was highly praised by Pouteau.

From what has been said of internal remedies, it is evident, that none of them can be regarded as means at all to be depended upon, for arresting the ravages of hospital gangrene, however advantageous they may prove in palliating general symptoms, removing particular complications, enabling the system to support the effects of the local disorder for a greater length of time, or, in a few cases, even placing nature in a condition to throw off the diseased parts herself, and communicate to the subjacent living flesh a healthy action.

If credit can be given to several of the authors, who have had the most extensive opportunities of attending to the nature of hospital gangrene, the local treatment is far more effectual than internal medicines.

" I was told by several of the French surgeons (says a late visiter to Paris), that they did not rely at all on internal means for stopping the progress of hospital gangrene, and that their experience had proved them to be insufficient, if not wholly inefficacious. Dupuytren, in reply to the account I gave him of the practice and opinions of English surgeons on this subject, assured me, that he had no confidence in any but local applications, and that internal remedies alone, as far as he had found, did almost nothing." The same remark has been made in a modern publication on hospital gangrene (*Delpech, Mém. sur la Complication des Plaies, &c.* 1815), " although it seems to be rather at variance with its being a constitutional and contagious disease, which the author has admitted." (See *Sketches of the Medical Schools of Paris, by J. G. Crosse*, p. 83.)

Perhaps, every antiseptic application that can be mentioned, has been tried as a dressing for wounds, or ulcers, affected with hospital gangrene. All watery applications, and common poultices and fomentations, are generally condemned, as inefficacious, and even hurtful. Dr. Boggie, however, is an advocate for cold lotions in the incipient inflammatory stage. Solutions of the chlorides of lime and soda have also been tried, and various reports made of their efficacy. I believe, that they will not stop true hospital gangrene.

Dussassoy was convinced, by the observation of numerous cases, that the best application is powder of bark. He recommends the wound to be covered with several layers of this powder, which are then to be moistened with turpentine. When this composition dries, he asserts, that it forms a fragile sort of coat, at the sides of which, and through which, the discharge escapes. After twenty-four hours the first coat is to be removed, and a fresh one applied. In general, according to this writer, four or five such dressings are sufficient in simple cases, where the disorder is confined to the skin and cellular substance. Healthy inflammation then occurs, the sloughs come away, and the wound puts on a healing appearance. In bad cases, Dussassoy sometimes added one-fifth of powdered muriate of ammonia to the bark. When this treatment failed, the actual cautery was used.

On the subject of bark, as a local application to hospital gangrene, I need only remark, that it is now entirely relinquished, either as possessing no efficacy (*Delpech*), or even aggravating the symptoms (*Blackadder*).

The milder forms of the disease appear sometimes to have yielded to the application of the vegetable and diluted mineral acids; viz. lime-juice, lemon-juice, vinegar; and the diluted nitric and muriatic acids. And the same observation may be made, with respect to solutions of the nitrates of silver and mercury. The two latter substances, and the oxygenated muriatic acid, and gas, were found by Dr. Rollo to be capable of effecting cure. Delpech, in particular, speaks of the benefit derived from the application of strong vinegar, after all the pulpy viscid matter has been carefully wiped away from the surface of the living flesh. The vinegar is then poured on the ulcer, which is to be covered with charpie wet with the same liquid. When the case is too far advanced for this treatment to answer, Delpech tries caustics, especially the nitrate of silver; and, if these fail, he has recourse to the actual cautery; and when the sloughs are very thick, so as to hinder the cautery from acting to a sufficient depth, he prefers thrusting into the sloughs, down to the living flesh, angular pieces of caustic potash at small distances from each other! (*Précis Elém. des Mal. Chir.* t. i. p. 151.) Surely, this must be far more torturing, and less certain of success, than removing the sloughs, and applying the cautery.

Though the actual cautery is generally admitted to be one of the most powerful means of stopping the progress of hospital gangrene, the surgeons of this country entertain a strong aversion to the practice; and I confess, that my own dislike to it is such as would always lead me to prefer any other treatment, from which equal efficacy would result. At the same time, it must be granted, that if the actual cautery will more certainly arrest some forms of hospital gangrene, than any other known applications, the surgeon's duty is to put out of the question his own prejudices against it, and consider only his patient's welfare. I am far from thinking, however, that while there are such powerful caustics as the undiluted mineral acids, and a dressing so effectual as a solution of arsenic, it can often be absolutely necessary to employ red-hot irons.

The merit of having pointed out in modern times the great efficacy of Fowler's solution of arsenic, or liquor arsenicalis, as an application to phagedæna gangrænosa, belongs to Mr. Blackadder. In answer to the objection, that the external use of arsenic is not unattended with danger, he assures us, that he has heard but of one instance of hospital gangrene, in which any deleterious effects were supposed to arise from the absorption of the arsenic; and the patient in question was very soon cured of his uneasy, and possibly merely nervous symptoms. (P. 50.)

"The first thing to be attended to in every case of disease (says Mr. Blackadder) is *cleanliness*, which, if always of great importance, is, in this instance, indispensable. The surface of the body ought to be made, and kept, perfectly clean, by means of the tepid bath, or otherwise, by a plentiful use of soap; and the linen, and bed-clothes, should be frequently changed, particularly when soiled with matter from the sore." In order to make the sore perfectly clean, and free it from the viscous discharge, without producing considerable bleeding, and pain, Mr. Blackadder recommends two large tin hospital teapots to be filled with a weak solution of the subcarbonate of potass. One of these solutions is to be cold, the other tepid; because sometimes one, and sometimes the other, is found most agreeable to the patient's feelings, though the warm is the most effectual in cleansing the sore. The liquid is to be poured over the sore, and received into a basin, which ought to be immediately emptied into another vessel placed at a distance from the patient. During this ablution, the glutinous matter, which adheres to the sore, may be gently detached, by means of small dossils of fine tow, or lint; but these (says Mr. Blackadder) should never be used for two different patients, rigid economy, on occasions such as this, being a very mistaken principle. In these cases, the use of sponges (he justly observes) ought to be entirely laid aside, as they can seldom be used more than once with safety. When the sore has been thus cleaned, a piece of fine dry lint is to be spread over its surface, and gently pressed into all its depressions with the points of the fingers. When the lint is removed, a quantity of the discharge will be found adhering to it; and this operation must be repeated with fresh pieces of lint, until the surface of the sore is made perfectly clean and dry.

According to Mr. Blackadder, the solution of arsenic will generally be found strong enough, when diluted with an equal part of water; but, in slight cases, it answered, when weakened with twice its quantity of water; and, in a few examples, it was employed without being at all diluted. Several pieces of lint of the same shape as the sore, but a little larger, are to be prepared: one of these, soaked in the solution, is now to be applied to the cleaned surface of the sore, and renewed, every fifteen or thirty minutes, according to the time in which it becomes dry. When the heat and inflammation are considerable, great relief will be derived from the frequent application of linen cloths, moistened with cold water, which must be kept from weakening the arsenical solution by means of a small piece of oil-skin laid over the pieces of lint. When the disease extends into the track of a gunshot wound, Mr. Blackadder uses a syringe for cleaning the sore and introducing the solution. "A slip of fine lint, well soaked in the solution, may also be inserted by means of a probe, into the bottom of the wound; and when the openings are at no great distance (from each other), and not in the immediate vicinity of the large nerves, and blood-vessels, the lint may be drawn through the wound in the form of a seton." (P. 53.) When the pain caused by the application is very severe, and the constitution is irritable, and debilitated, Mr. Blackadder prescribes an opiate, though he remarks, that this practice will seldom be absolutely necessary. The morbid action in the sore is destroyed by the arsenical solution sooner, or later, in different cases: *the best plan is to continue the application, until an insensible, dark-coloured, dry slough, occupies the whole surface of the sore, and until the patient is completely relieved from the burning and lancinating pain.*

After the slough is formed, Mr. Blackadder employs an ointment, composed of equal parts of the oil of turpentine and the yellow resinous ointment, or, of two parts of venice turpentine to one of the resinous ointment. "These, being melted and mixed together, are to be poured over the sore, as hot as the patient can possibly bear." A pledget of dry lint, or tow, and a bandage, are then applied; and this dressing may be renewed two or three times a day, the sore being each time carefully washed with the solution of potass. As soon as any part of the slough is loosened, Mr. Blackadder removes it with a pair of curved scissors. With the view of expediting the separation of the slough, he sometimes employed a linseed-meal poultice, which had the desired effect, but was found to be too relaxing. When it is used, therefore, Mr. Blackadder found it expedient, at each dressing, to touch the new granulations with the nitrate of silver.

After the detachment of the slough, Mr. Blackadder dresses the sore with the above mentioned ointment cold, or with the addition of a small proportion of the subacetate of copper. The pledget of this ointment is covered with a piece of oil-skin, lightly rubbed over with soap, and a firm bandage is applied to the whole limb. (See *Obs. on Phagedæna Gangrænosa*, p. 49, &c. 8vo. Edinb. 1818.) The author declares, that, after the introduction of the above treatment (with the exception of stumps attacked with hospital gangrene), he never saw an instance, in which the remedy failed, when applied in time, and in a proper manner; "that is, before the disease had made such progress, as to preclude all rational hope of success from that, or any other mode of treatment." (P. 23.)

In Dr. Rollo's Treatise on Diabetes, published in 1797, the opinion is plainly stated, that the progress of hospital gangrene might be stopped by very active topical applications, and, in the same work, Mr. Cruikshank says, that, "if an actual caustic were to be employed, we should have recourse to the strong nitrous acid." According to Mr. Blackadder, the oxygenated muriate of mercury, and the nitrous acid, were much recommended and employed by surgeons, in the 16th and 17th centuries, as escharotics, in cases of gangrene and foul ulcers. (P. 113.) Several army-surgeons have informed me, that the undiluted nitrous acid was successfully used as an application to hospital gangrene in the military hospitals at Antwerp, in the year 1815; but, that other strong acids had an equally good effect. Dr. J. Thomson also notices, that, "the application of caustic substances, such as the strong mineral acids, the solutions of potass, corrosive sublimate, and arsenic, seemed at Antwerp to arrest the progress of this sore, without exciting inflammation." (*Report of Obs. made in the Military Hospitals in Belgium.*)

Delpech was informed by some British surgeons, belonging to the Anglo-Portuguese army in the Peninsula, that the muriatic acid was in common use in the hospitals of that army, as a local application for checking the ravages of hospital gangrene, being employed in a diluted state for slight cases, and in a concentrated caustic form for others.

In St. Bartholomew's Hospital, the undiluted nitric acid has been used with great success, as a local application to phagedenic gangrenous ulcers. "If the disease be not far advanced (says Mr. Welbank), I at once apply the undiluted acid, after cleansing the surface with tepid water, and absorbing the moisture with lint. Where, however, there is a thick and pulpy slough, it is better to remove as much of it as possible, with forceps and scissors, before the application is made. The surrounding parts being then protected by a thick coating of lard, or cerate, I proceed to press steadily, and for some minutes, a thick pledget of lint, previously immersed in the undiluted acid, on every point of the diseased surface, till it appears converted into a firm and dry mass. The parts may be then covered with simple dressings, and evaporation kept up by cooling lotions. As the application occasions more or less pain, from half an hour to one or two hours, I have generally given 20 or 30 drops of laudanum at the time of using it. It is always prudent, often necessary, to remove the eschar at the end of 16 or 20 hours." When the patients have become perfectly free from pain, and the parts below the slough are found healthy and florid, Mr. Welbank treats the sore as a common wound or ulcer, though he has found stimulating dressings generally the best, as the ceratum lapidis caliminaris, or a solution of two or three grains of the nitrate of silver in an ounce of distilled water. But, when there is a recurrence of pain at any point, or over the general surface of the sore, whether the affection be slight or severe, the slough superficial or deep, he recommends the employment of the undiluted acid again. (See *Med. Chir. Trans.* vol. xi. p. 369.)

Pouteau, Dussassoy, Boyer, and Delpech, all bear testimony to the efficacy of the actual cautery, and they repeat the application of it, until the whole surface of the ulcer is converted into a firm hard eschar. Even the edges of the solution of continuity should not be spared—"*Ils doivent être torréfiés et rôtis pour ainsi dire.*" (*Boyer, Maladies Chir.* t. i. p. 332.) The latter surgeon then covers the eschar with a thick stratum of bark, moistened with turpentine. This application is to be removed in twenty-four, thirty-six, or forty-